NAVMED P-5010-1

Chapter 1
Manual of Naval Preventive Medicine
Food Safety

CHANGE TRANSMITTAL 1
Change to Article 3-2.6

26 May 2004

To: Holders of the Manual of Naval Preventive Medicine

1. **Purpose.** To revise policy and procedures for food safety procedures and practices regarding the handling and preparation of fresh fruits and vegetables for the Department of the Navy. This revision is consistent with current food safety procedures found in the Federal Food and Drug Administration Food Code and practices of other military services.

2. **Action.** Remove page 55 and replace with revised page 55 and new pages 55a and 55b of enclosure (1). Keep this change transmittal in front of publication.

K. L. Martin

K. L. MARTIN
Vice Chief
Bureau of Medicine and Surgery

3-2.5 Pasteurized Eggs, Substitute for Shell Eggs for Certain Recipes and Populations

Pasteurized liquid, frozen, or dry eggs or egg products shall be substituted for shell eggs in the preparation of:

a. Foods such as Caesar salad dressing, hollandaise or béarnaise sauce, mayonnaise, eggnog, ice cream, and egg-fortified beverages.

b. Eggs for a highly immunocompromised or otherwise susceptible population.

3-2.6 Washing Fruits and Vegetables

a. Fresh fruits and vegetables should be procured only from approved sources.

b. Fresh fruits and vegetables from approved sources, shall be thoroughly washed in clean, potable water to remove soil and other contaminants before being cut, combined with other ingredients, cooked, served, or offered for human consumption in ready-to-eat form. Head/stalk produce such as lettuce, cabbage and celery, etc. must be broken apart during washing to enhance contact to head/stalk produce surfaces.

c. For fresh fruits and vegetables from unapproved sources, as well as those suspected of being contaminated with pathogenic organisms, the following is recommended:

1. First, wash fresh fruits and vegetables as described in 3-2.6b.

2. Then subject the fresh fruits and vegetables to a chemical wash (refer to 3-2.6d) using an approved direct food contact additive.

3. Following the chemical wash, thoroughly rinse the fresh fruits and vegetables with clean potable water before being cooked and/or served to the consumer.

d. Recommended chemical wash solution and procedures. Sodium hypochlorite 5% (unscented bleach) is generally recommended for use. Fresh fruits and vegetables may be

3-2.6 Washing Fruits and Vegetables (Continued)

chemically washed by immersion in a 50 ppm free available chlorine (FAC) solution for 1-2 minutes. A 50 ppm FAC solution may be made by adding 1.5 tablespoons of 5% Sodium hypochlorite to 5 gallons of potable water or a Calcium hypochlorite (70%) FAC solution may also be used. To make a Calcium hypochlorite 50 ppm FAC solution add 1 tablespoon of Calcium hypochlorite (70%) to 25 gallons of potable water. Use the correct chemical test paper (strips) to match the chemical wash solution to periodically monitor the FAC to verify that chemical strength (50 ppm FAC) is maintained. It is especially important to follow these procedures due to quality and taste of these food items. Note: other chemical solutions or products may be used if approved as an FDA direct food contact additive. Chemical sanitizers approved for dishware, utensils, and other food contact surfaces are not necessarily FDA approved for washing fresh fruits and vegetables.

3-2.7 Ice used as Exterior Coolant is Prohibited from Reuse

Ice may not be used as food after it has been used as a medium for cooling the exterior surfaces of food such as melons or fish, packaged foods, canned beverages, or cooling coils and tubes of equipment.

3-2.8 Single use Gloves, used for one Purpose and Discarded

If used, single use gloves shall be used for only one task such as working with ready-to-eat food or with raw animal food, used for no other purpose, and discarded when damaged or soiled, or when interruptions occur in the operation.

THIS PAGE INTENTIONALLY LEFT BLANK

DEPARTMENT OF THE NAVY
BUREAU OF MEDICINE AND SURGERY
2300 E STREET NW
WASHINGTON DC 20372-5300

IN REPLY REFER TO

6200
Ser 24/99U24070
17 Aug 99

From: Chief, Bureau of Medicine and Surgery
To: Ships and Stations Having Medical Department Personnel

Subj: NAVMED P-5010, MANUAL OF NAVAL PREVENTIVE MEDICINE, CHAPTER 1, FOOD SAFETY

1. The revision to the Naval Preventive Medicine Manual (NAVMED Pub P-5010) Chapter on Food Safety is complete. Chapter 1 of the previous version of P-5010 is hereby cancelled.

2. This chapter can be found under publications on the Virtual Naval Hospital's web site: http://www.vnh.org. Forms found in the revised chapter will have a preprinted standard stock number at the bottom or can be accessed via these web sites: http://web1.whs.osd.mil/icdhome/DDEFORMS.HTM or http://web1.whs.osd.mil/icdhome/SFEFORMS.HTM.

3. For follow up to this manual and its chapter, contact the Preventive Medicine directorate at the Navy Environmental Health Center, Norfolk, Virginia. Telephone: COM (757)462-5591/5451 DSN 864-.

S. T. FISHER
Deputy Chief

MANUAL OF NAVAL PREVENTIVE MEDICINE
CHAPTER 1
FOOD SAFETY

TABLE OF CONTENTS

SECTION IV STANDARDS AND SANITATION OF FOOD SERVICE EQUIPMENT AND UTENSILS

SECTION V STRUCTURAL REQUIREMENTS AND SANITARY CONTROLS

SECTION VI INSPECTION REPORTING PROCEDURES

APPENDIX A FOOD BORNE ILLNESSES

APPENDIX B REFERENCES

APPENDIX C MODEL FORMS

TABLES AND FIGURES

CHAPTER 1, FOOD SAFETY

Section I GENERAL INFORMATION

1-1 INTRODUCTION

a. This chapter provides guidance for all military and non-military personnel of the Navy, Marine Corps and the Military Sealift Command involved with food safety/food service sanitation.

b. This chapter is based on the U.S. Public Health Service, Food and Drug Administration (FDA) "Food Code," which may also be used for guidance. When principles and procedures in these publications vary, this chapter must take precedence.

1-2 PURPOSE

This chapter prescribes the policies, procedures, and responsibilities for implementing the Navy and Marine Corps Food Safety/Food Service Sanitation Program. It applies to all food service operations within the Navy and Marine Corps, including the Military Sealift Command, Naval Reserve and Marine Corps Reserve.

1-3 DEFINITIONS

a. The following definitions of words and terms apply in the interpretation of this chapter.

b. Terms defined.

(1) **Additive.**

(a) "**Food additive**" means any substance the intended use of which results or may reasonably be expected to result, directly or indirectly, in its becoming a component or otherwise affecting the characteristics of any food (including any substance intended for use in producing, manufacturing, packing, processing, preparing, treating, packaging, transporting, or holding food; and including any source of radiation intended for any such use), if such substance is not generally recognized, among experts qualified by scientific training and experience to evaluate its safety, as having been adequately shown through scientific procedures (or, in the case as a substance used in food prior to January 1, 1958, through either scientific procedures or experience based on common use in food) to be safe under the conditions of its intended use; except that such term does not include:

1 A pesticide chemical in or on a raw agricultural commodity; or

2 A pesticide chemical to the extent it is intended for use or is used in the production, storage, or transportation of any raw agricultural commodity; or

3 A color additive; or

4 Any substance used under a sanction or approval granted prior to September 6, 1958, pursuant to this chapter, the Poultry Products Inspection Act (21 U.S.C. 451 et seq.) or the Meat Inspection Act of March 4, 1907, as amended and extended (21 U.S.C. 601 et seq.); or

5 A new animal drug.

(b) "**Color additive**" means a material which:

1 Is a dye, pigment, or other substance made by a process of synthesis or similar artifice, or extracted, isolated, or otherwise derived, with or without intermediate or final change of identity, from a vegetable, animal, mineral, or other source, and

2 When added or applied to a food, drug, or cosmetic, or to the human body or any part thereof, is capable (alone or through reaction with other substance) of imparting color thereto; except that such term does not include any material which, by regulation, determined is used (or intended to be used) solely for a purpose or purposes other than coloring.

3 The term "color" includes black, white, and intermediate grays.

4 Nothing in subparagraph (b) of this paragraph shall be construed to apply to any pesticide chemical, soil or plant nutrient, or other agricultural chemical solely because of its effect in aiding, retarding, or otherwise affecting, directly or indirectly, the growth or other natural physiological processes of produce of the soil and thereby affecting its color,

whether before or after harvest.

(2) **"Adulterated"** means the condition of a food if it:

(a) Bears or contains any poisonous or deleterious substance in a quantity which may render it injurious to health;

(b) Bears or contains added poisonous or deleterious substance for which no safe tolerance has been established;

(c) Consists in whole or part of any filthy, putrid, or decomposed substance, or if it is otherwise unfit for human consumption;

(d) Has been processed, prepared, packed, or held under unsanitary conditions, whereby it may have become contaminated with filth, or whereby it may have been rendered injurious to health;

(e) Is in a container composed in whole, or in part, of any poisonous or deleterious substance which may render the contents injurious to health.

(3) **"Advance Preparation"** is defined as food that is prepared for future service beyond a specific meal. Advance preparation foods must be immediately cooled after cooking to 41°F or below within 4 hours.

(4) **"Approved"** means acceptable to the Chief, Bureau of Medicine and Surgery (CHBUMED) based on determination of conformity with principles, practices, and generally recognized standards that protect public health.

(5) **"a_w"** means water activity which is a measure of the free moisture in a food, is the quotient of the water vapor pressure of the substance divided by the vapor pressure of pure water at the same temperature, and is indicated by the symbol a_w.

(6) **"Beverage"** is a liquid for drinking, including water.

(7) **"Bottled Drinking Water"** means water that is sealed in bottles, packages, or other containers and offered for sale for human consumption.

(8) **"Bulk Food"** is defined as the greater part; the main mass or body and in most cases can be described by goods or cargo in large packages, boxes, bags, etc.

(9) **"Certification Number"** is a unique combination of letters and numbers assigned to a shellfish control authority to a molluscan shellfish dealer according to the provisions of the National Shellfish Sanitation Program.

(10) **CIP.**

(a) **"CIP"** means cleaned in place by the circulation or flowing by mechanical means through a piping system of a detergent solution, potable water rinse, and sanitizing solution onto or over equipment surfaces that require cleaning, such as the method used, in part, to clean and sanitize a frozen desert machine.

(b) **"CIP"** does not include the cleaning of equipment such as band saws, slicers or mixers that are subject to in place manual cleaning without the use of a CIP system.

(11) **"CFR"** means Code of Federal Regulations. Citations in this chapter to the CFR refer sequentially to the Title, Part, and Section numbers, such as 21 CFR 178.1010 refers to Title 21, Part 178, Section 1010.

(12) **"Code of Federal Regulations"** means the compilation of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal Government which:

(a) Is published annually by the U.S. Government Printing Office;

(b) Contains FDA rules in 21 CFR, USDA rules in 7 CFR, and EPA rules in 40 CFR.

(13) **Comminuted.**

(a) **"Comminuted"** means reduced in size by methods including chopping, flaking, grinding, or mincing.

(b) **"Comminuted"** includes fish or meat products that are reduced in size and restructured or reformulated such as gefilte fish, formed roast beef, gyros, ground beef, and sausage;

and a mixture of two or more types of meat that have been reduced in size and combined, such as sausages made from two or more meats.

(14) **Common Dining Area.**

(a) "**Common dining area**" is a central location where people gather to eat at mealtime.

(b) "**Common dining area**" does not apply to a kitchenette or dining area located within a resident's private living quarters.

(15) "**Confirmed Disease Outbreak**" is a food borne disease outbreak in which laboratory analysis of appropriate specimens identifies a causative organism and epidemiological analysis implicates the food as the source of the illness.

(16) "**Consumer**" is a person who is a member of the public, takes possession of food, is not functioning in the capacity of an operator of a food establishment or food processing plant, and does not offer the food for resale.

(17) "**Corrosion Resistant Material**" means a material that maintains acceptable surface cleanability characteristics under prolonged influence of the food to be contacted, the normal use of cleaning compounds and sanitizing solutions, and other conditions of the use environment.

(18) "**Critical Control Point**" is a point or procedure in a specific food system where loss of control may result in an unacceptable health risk.

(19) "**Critical Item**" is a provision of HACCP that, if in noncompliance, is more likely than other violations to contribute to food contamination, illness, or environmental degradation.

(20) "**Critical Limit**" is the maximum or minimum value to which a physical, biological, or chemical parameter must be controlled at a critical control point to minimize the risk that the identified food safety hazard may occur.

(21) "**Cross Connection**" is any physical connection or arrangement between two otherwise separate piping systems, one of which contains potable water, and the other, water of unknown or questionable safety, steam, other gases or liquids, whereby there

may be a flow from one system to the other; any actual or potential connection between a public water supply and a source of contamination or pollution.

(22) **Drinking Water.**

(a) "**Drinking water**" means water that meets 40 CFR Part 141, National Primary Drinking Water Regulations.

(b) "**Drinking water**" is traditionally known as potable water.

(c) "**Drinking water**" includes the term "**water**" except where the term used connotes the water is not potable, such as boiler water, mop water, rainwater, wastewater, and nondrinking water.

(23) "**Dry Storage Area**" is a room or area designated for the storage of packaged or containerized bulk food that is not potentially hazardous to dry goods such as single service items.

(24) **Easily Cleanable.**

(a) "**Easily cleanable**" is a characteristic of a surface that:

1 Allows removal of soil by normal cleaning methods;

2 Is dependent on the material, design, construction, and installation of the surface; and

3 Varies with the likelihood of the surface's role in introducing pathogenic or toxigenic agents or other contaminants into food based on the surface's approved placement, purpose, and use.

(b) "**Easily cleanable**" includes a tiered application of the criteria that qualify the surface as easily cleanable as specified in subparagraph (a) of this definition to different situations in which varying degrees of cleanability are required such as:

1 The appropriateness of stainless steel for a food preparation surface as opposed to the lack of need for stainless steel to be used for floors or for tables used for

consumer dining; or

2 The need for a degree of cleanability for a utilitarian attachment or accessory in the kitchen as opposed to a decorative attachment or accessory in the consumer dining area.

(25) **Easily Movable.**

(a) "**Easily movable**" means weighing 14 kg (30 pounds) or less; mounted on casters, gliders, or rollers; or provided with a mechanical means requiring no more than 14 kg (30 pounds) of force to safely tilt a unit of equipment for cleaning; or

(b) Having no utility connection, a utility connection that disconnects quickly, or a flexible utility connection line of sufficient length to allow the equipment to be moved for cleaning of the equipment and adjacent area.

(26) "**Employee**" is the permit holder, person in charge, person having supervisory or management duties, person on the payroll, family member, volunteer, person performing work under contractual agreement, mess management specialist, mess cook, food service officer, or other person working in a food establishment.

(27) "**EPA**" refers to the U.S. Environmental Protection Agency.

(28) **Equipment.**

(a) "**Equipment**" is an article that is used in the operation of a food establishment such as a freezer, grinder, hood, ice maker, meat block, mixer, oven, reach-in refrigerator, scale, sink, slicer, stove, table, temperature measuring device for ambient air, vending machine, or water activity machine.

(b) "**Equipment**" does not include items used for handling or storing large quantities of packaged foods that are received from a supplier in a cased or overwrapped lot, such as hand trucks, forklifts, dollies, pallets, racks, and skids.

(29) "**Fish**" means fresh or saltwater finfish, molluscan shellfish, crustaceans, and other forms of aquatic animal life other than birds or mammals and includes any edible human food product derived in whole or in part from fish, including fish

that has been processed in any manner.

(30) "**Food**" means a raw, cooked, or processed edible substance, ice, beverage, or ingredient used or intended for use or for sale in whole or in part for human consumption, or chewing gum.

(31) **Food Borne Disease Outbreak.**

(a) "**Food borne disease outbreak**" is an incident, except as specified in subparagraph (b) of this definition, in which:

1 Two or more persons experience a similar illness after ingestion of a common food;

2 Epidemiological analysis implicates the food as the source of the illness.

(b) "**Food borne disease outbreak**" includes a single case of illness such as one person ill from botulism or chemical poisoning.

(32) "**Food Contact Surface**" means:

(a) A surface of equipment or a utensil with which food normally comes into contact; or

(b) A surface of equipment or a utensil from which food may drain, drip, or splash:

1 Into a food, or

2 Onto a surface normally in contact with food.

(33) "**Food Code**" is the current edition of the U.S. Public Health Service, Food and Drug Administration, "Food Code."

(34) "**Food Employee**" means an individual working with unpackaged food, food equipment or utensils, or food contact surfaces.

(35) **Food Establishment.**

(a) "**Food Establishment**" means an operation that stores, prepares, packages, serves, vends, or otherwise provides food for human consumption:

1 Such as a food service facility, galley, restaurant; satellite or catered feeding location; catering operation if the operation provides food directly to a consumer or to a conveyance used to transport people; market; vending location; institution; or food bank; and

2 That relinquishes possession of food to a consumer directly, or indirectly through a delivery service such as a home delivery or grocery orders or a restaurant takeout orders, or delivery service that is provided by common carriers.

(b) "**Food Establishment**" includes:

1 An element of the operation such as a transportation vehicle or a central preparation facility that supplies a vending location or a satellite feeding location unless the vending or feeding location is permitted by the regulatory authority; and

2 An operation conducted in a mobile, stationary, temporary, or permanent facility or location: where consumption is on or off the premises; and regardless of whether there is a charge for the food.

(c) "**Food Establishment**" does not include:

1 An establishment that offers only prepackaged foods that are not potentially hazardous;

2 A produce stand that offers whole, uncut fresh fruits and vegetables;

3 A food processing plant;

4 A kitchen in a private home if only food that is not potentially hazardous is prepared for sale or service at a function such as a religious or charitable organization's bake sale if allowed by law and if the consumer is informed by a clearly visible placard at the sales or service location that the food is prepared in a kitchen that is not subject to regulation and inspection by the regulatory authority;

5 An area where food that is prepared as specified in subparagraph (c)(4) of this definition is sold or

offered for human consumption;

6 A kitchen in a private home, such as a small family day care provider, or a bed and breakfast operation that prepares and offers food to guests if the home is occupied, the number of available guests bedrooms does not exceed six, breakfast is the only meal offered, the number of guests served does not exceed 18, and the consumer is informed by statements contained in published advertisements, mailed brochures, and placards posted at the registration area that food is prepared in a kitchen that is not regulated and inspected by the regulatory authority; or

7 A private home that receives catered or home delivered food.

(36) **Food Processing Plant.**

(a) "**Food processing plant**" means a commercial operation that manufactures, packages, labels, or stores food for human consumption and does not provide food directly to a consumer.

(b) "**Food processing plant**" does not include a food establishment as defined in subparagraph (35b) above.

(37) **Game Animal.**

(a) "**Game animal**" means an animal, the products of which are food, that is not classified as cattle, sheep, swine, goat, horse, mule, or other equine in 9 CFR Subchapter A - Mandatory Meat Inspection, Part 301, as Poultry in 9 CFR Subchapter C - Mandatory Poultry Products Inspection, Part 381, or as fish as defined in subparagraph 1-201.10(B)(25).

(b) "**Game animal**" includes mammals such as reindeer, elk, deer, antelope, water buffalo, bison, rabbit, squirrel, opossum, raccoon, nutria and muskrat; and nonaquatic reptiles such as land snakes.

(c) "**Game animal**" does not include rarities such as ostrich, emu, and rhea.

(38) "**Grade A Standards**" means the requirements of the USPHS/FDA Grade A Pasteurized Milk Ordinance" and "Grade A Condensed and Dry Milk Products and Condensed and Dry Whey" with

which certain fluid and dry milk and milk products comply.

(39) **"General Use Pesticide"** is a pesticide that is not classified by EPA for restricted use as specified in 40 CFR 152.175.

(40) **Group Residence.**

(a) **"Group residence"** is a private or public housing corporation or institutional facility that provides living quarters and meals.

(b) **"Group residence"** includes a domicile for unrelated persons such as a retirement home or a long term health care facility.

(41) **"HACCP Plan"** is a written document that delineates the formal procedures for following the **H**azard **A**nalysis **C**ritical **C**ontrol **P**oint principles developed by the National Advisory Committee on Microbiological Criteria for Foods.

(42) **"Hazard"** means a biological, chemical, or physical property that may cause an unacceptable consumer health risk.

(43) **"Hermetically Sealed Container"** is a container designed and intended to be secure against the entry of microorganisms and, in the case of low acid canned foods, to maintain the commercial sterility of its contents after processing.

(44) **"Highly Susceptible Population"** is a group of persons who are more likely than other populations to experience food borne disease because they are immunocompromised or older adults and in a facility that provides health care or assisted living services, such as a hospital or nursing home; or preschool age children in a facility that provides custodial care, such as a child development center.

(45) **"Imminent Health Hazard"** is a significant threat or danger to health considered to exist when there is evidence sufficient to show that a product, practice, circumstance, or event creates a situation that requires immediate correction or cessation of operation to prevent injury based on:

(a) The number of potential injuries, and

(b) The nature, severity, and duration of the anticipated injury.

(46) "**Injected**" means manipulating a meat so that infectious or toxigenic microorganisms may be introduced from its surface to its interior through tenderizing with deep penetration or injecting the meat with juices which may be referred to as "injecting," "pinning," or "stitch pumping."

(47) "**Kitchenware**" means food preparation and storage utensils.

(48) "**Law**" means applicable military directives, local, state, and Federal statutes, regulations, and ordinances.

(49) "**Leftover**" means any unserved food remaining at the end of the meal period for which it is prepared.

(50) "**Linens**" are fabric items such as cloth hampers, cloth napkins, tablecloths, wiping cloths, and work garments including cloth gloves.

(51) "**Meat**" means the flesh of animals used as food including the dressed flesh of cattle, swine, sheep, or goats and other edible animals, except fish and poultry, that is offered for human consumption.

(52) "**mg/L**" is milligrams per liter, the metric equivalent of parts per million (ppm).

(53) "**Molluscan shellfish**" are any edible species of fresh or frozen oysters, clams, mussels, and scallops or edible portions thereof, except when the scallop product consists only of the shucked adductor muscle.

(54) **Packaged.**

(a) "**Packaged**" means bottled, canned, cartoned, securely bagged, or securely wrapped, whether packaged in a food establishment or a food processing plant.

(b) "**Packaged**" does not include a wrapper, carryout box, or other nondurable container used to containerize food with the purpose of facilitating food protection during service and receipt of the food by the consumer.

(55) "**Pathogen**" means a disease causing agent or microorganism.

(56) "**Permit**" is the document issued by the regulatory authority that authorizes a person to operate a food establishment.

(57) "**Permit Holder**" means the entity that:

(a) Is legally responsible for the operation of the food establishment such as the owner, the owner's agent, or other person; and

(b) Possesses a valid permit to operate a food establishment.

(58) "**Person**" is an association, a corporation, individual, partnership, other legal entity, Government, or governmental subdivision or agency.

(59) "**Person in Charge**" is the individual present at a food establishment responsible for the operation at the time of inspection.

(60) **Personal Care Items.**

(a) "**Personal care items**" are substances that may be poisonous, toxic, or a source of contamination used to maintain or enhance a person's health, hygiene, or appearance.

(b) "**Personal care items**" include medicines, first aid supplies, cosmetics and toiletries.

(61) "**pH" is** the symbol for the negative logarithm of the hydrogen ion concentration, which is a measure of the degree of acidity or alkalinity of a solution. Values between 0 and 7 indicate acidity and values between 7 and 14 indicate alkalinity. The value of pure distilled water is 7, which is considered neutral.

(62) "**Physical Facilities**" means the structure and interior surfaces of a food establishment including accessories such as soap and towel dispensers and attachments such as light fixtures and heating or air-conditioning system vents.

(63) "**Plumbing Fixture**" is a receptacle or device that:

(a) Is permanently or temporarily connected to the water distribution system of the premises and demands a supply of water from the system; or

(b) Discharges used water, waste materials, or sewage directly or indirectly to the drainage system of the premises.

(64) "**Plumbing System**" means the water supply and distribution pipes; plumbing fixtures and traps; soil, waste, and vent pipes; sanitary and storm sewers and building drains, including their respective connections, devices, and appurtenances within the premises; and water treating equipment.

(65) "**Poisonous or Toxic Materials**" are substances that are not intended for ingestion and included in four categories:

(a) Cleaners and sanitizers, which include cleaning and sanitizing agents and agents such as caustics, acids, drying agents, polishes, and other chemicals;

(b) Pesticides, which include substances such as insecticides and rodenticides;

(c) Substances necessary for the operation and maintenance of the establishment such as nonfood grade lubricants and personal care items that may be deleterious to health;

(d) Substances that are not necessary for the operation and maintenance of the establishment and are on the premises for retail sale, such as petroleum products and paints.

(66) **PHF - Potentially Hazardous Food.**

(67) **Potentially Hazardous Food.**

(a) "**Potentially hazardous food**" means a food that is natural or synthetic and that requires temperature control because it is in a form capable of supporting:

1 The rapid and progressive growth of infectious or toxigenic microorganisms;

2 The growth and toxin production of *Clostridium botulinum;* or

3 In raw shell eggs, the growth of *Salmonella enteritidis*.

(b) **"Potentially hazardous food"** includes an animal food (a food of animal origin) that is raw or heat treated; a food of plant origin that is heat treated or consists of raw seed sprouts; cut melons; and garlic oil mixtures that are not acidified or otherwise modified at a food processing plant in a way that results in mixtures that do not support growth as specified under subparagraph (a) of this definition.

(c) **"Potentially hazardous food"** does not include:

1 An air-cooled hard-boiled egg with shell intact;

2 A food with a a_w value of 0.85 or less;

3 A food with a pH level of 4.6 or below when measured at 75° F (24° C);

4 A food in an unopened hermetically sealed container, that is commercially processed to achieve and maintain commercial sterility under conditions of nonrefrigerated storage and distribution; and

5 A food for which laboratory evidence demonstrates the rapid and progressive growth of infectious or toxigenic microorganisms or the growth of *S. enteritidis* in eggs or *C. botulinum* cannot occur, such as a food that has an a_w and a pH that are above the levels specified under subparagraphs (c)2 and 3 of this definition and that may contain a preservative, other barrier to the growth of microorganisms, or a combination of barriers that inhibit the growth of microorganisms.

6 A food that may contain an infectious or toxigenic microorganism or chemical or physical contaminant at a level sufficient to cause illness, but that does not support the growth or microorganisms as specified under subparagraph (a) of this definition.

(68) "**Poultry**" is any domesticated bird (chickens, turkeys, ducks, geese, or guineas), whether live or dead.

(69) "**Premises**" means:

(a) The physical facility, its contents, and the contiguous land or property under the control of the permit holder or food establishment;

(b) The physical facility, its contents, and the contiguous land or property and its facilities and contents that are under the control of the permit holder/food establishment that may impact food establishment personnel, facilities, or operations, if a food establishment is only one component of a larger organization such as a health care facility, hotel, motel, school, recreational camp, or prison.

(70) "**Preventive Medicine Authority (PMA)**" the medical department representatives responsible for public health (preventive medicine). This will be the senior environmental health officer/preventive medicine technician for the area of responsibility. In their absence Army veterinary technicians, independent duty corpsmen, senior general duty corpsmen or medical officers may be designated.

(71) "**Primal Cut**" is a basic major cut into which carcasses and sides of meat are separated. Examples include beef round, pork loin, lamb flank or veal breast.

(72) "**Prime Vendor**" is a commercial vendor designated by the Supply Department as an approved direct delivery vendor.

(73) "**Public Water System**" has the meaning stated in 40 CFR Part 141 National Primary Drinking Water Regulations.

(74) **Ready to Eat Food.**

(a) "**Ready to eat food**" means food in a form that is edible without washing, cooking, or additional preparation by the food establishment or the consumer and that is reasonably expected to be consumed in that form.

(b) "**Ready to eat food**" includes:

1 Unpackaged potentially hazardous food that is cooked to the temperature and time required for the specific food

under this chapter.

2 Raw, washed, cut fruits and vegetables;

3 Whole, raw, fruits and vegetables that are presented for consumption without the need for further washing, such as at a buffet; and

4 Other food presented for consumption for which further washing or cooking is not required and from which rinds, peels, husks, or shells are removed.

(75) **Reduced Oxygen Packaging.**

(a) "**Reduced oxygen packaging**" means the reduction of the amount of oxygen in a package by mechanically evacuating the oxygen; displacing the oxygen with another gas or combination of gases; or otherwise controlling the oxygen content in a package to a level below that normally found in the surrounding atmosphere, which is 21% oxygen.

(b) "**Reduced oxygen packaging**" includes methods that may be referred to as altered atmosphere, modified atmosphere, controlled atmosphere, low oxygen, and vacuum packaging including sous vide.

(76) "**Refuse**" means solid waste not carried by water through the sewage system.

(77) "**Regulatory Authority**" is the local, State, Federal enforcement body, or authorized representative having jurisdiction over the food establishment. In this publication the regulatory authority usually means the Preventive Medicine Authority.

(78) "**Restricted Use Pesticide**" is a pesticide product that contains the active ingredients specified in 40 CFR 152.175, Pesticides Classified For Restricted Use, and that is limited to use by or under the direct supervision of a certified applicator.

(79) "**Safe Material**" means:

(a) An article manufactured from or composed of materials that may not reasonably be expected to result, directly or indirectly, in their becoming a component or otherwise affecting the characteristics of any food;

(b) An additive that is used as specified in Paragraph 409 or 706 of the Federal Food, Drug, and Cosmetic Act.

(c) Other materials that are not additives and that are used in conformity with applicable regulations of the Food and Drug Administration.

(80) "**Sanitize or Sanitization**" is the application of cumulative heat or chemicals on cleaned food contact surfaces that, when evaluated for efficacy, yield a reduction of 5 logs, which is equal to 99.999% reduction, of representative microorganisms of public health importance.

(81) "**Sealed**" means free of cracks or other openings that allow the entry or passage of moisture.

(82) "**Servicing Area**" is an operating base where a mobile food establishment or transportation vehicle returns regularly for discharging liquid or solid wastes, refilling water tanks and ice bins, and boarding food.

(83) "**Sewage**" means liquid waste containing animal or vegetable matter in suspension or solution and may include liquids containing chemicals in solution.

(84) "**Shellfish Control Authority**" is a State, Federal, foreign, or other Government entity legally responsible for administering a program that includes certification of molluscan shellfish harvesters and dealers for interstate commerce.

(85) "**Shellstock**" means raw, in shell molluscan shellfish.

(86) "**Shucked Shellfish**" means molluscan shellfish that have had one or both shells removed.

(87) "**Single Service Articles**" include tableware, carry-out utensils, and other items such as bags, containers, placemats, stirrers, straws, toothpicks, and wrappers that are designed and constructed for one time, one person use.

(88) **Single Use Articles.**

(a) "**Single use articles**" are utensils and bulk food containers designed and constructed to be used once and discarded.

(b) "**Single use articles**" include items such as wax paper, butcher paper, plastic wrap, formed aluminum food containers, jars, plastic tubs or buckets, bread wrap, pickle barrels, ketchup bottles, and number 10 cans which do not meet the materials, durability, strength and cleanability specifications for multiuse utensils.

(89) "**Slacking**" is the process of moderating food temperature by allowing a food to gradually increase from a temperature of -10°F (-23° C) to 25° F (-4° C) in preparation for deep-fat frying or to facilitate even heat penetration during the cooking of previously block frozen food.

(90) "**Smooth**" means:

(a) A food contact surface having a surface free of pits and inclusions with a cleanability equal to or exceeding that of (100 grit) number 3 stainless steel.

(b) A nonfood contact surface of equipment having a surface equal to that of commercial grade hot-rolled steel free of visible scale.

(c) A floor, wall, or ceiling having an even level surface with no roughness or projections that render it difficult to clean.

(91) "**Sous Vide**" is a method of packaging raw or partially cooked food, where the product is placed in a sealed pouch with the air removed. The pouch is cooked and refrigerated or frozen until needed, reheated and served.

(92) "**Support Animal**" is a trained animal that accompanies a person with a disability to assist in managing the disability and enables the person to perform functions the person would otherwise be unable to perform.

(93) "**Table Mounted Equipment**" means equipment that is not portable and is designed to be mounted off the floor on a table, counter, or shelf.

(94) "**Tableware**" means eating, drinking, and serving utensils for table use such as flatware including forks, knives, and spoons; hollowware including bowls, cups, serving dishes,

tumblers; and plates.

(95) "**Temperature Measuring Device**" is a thermometer, thermocouple, thermistor, or other device that indicates the temperature of food, air, or water.

(96) "**Temporary Food Establishment**" is a food establishment that operates for a period of no more than 14 consecutive days in conjunction with a single event or celebration.

(97) "**Utensil**" is a food contact implement or container used in the storage, preparation, transportation, dispensing, sale, or service of food, such as kitchenware or tableware that is multiuse, single service, or single use; gloves used in contact with food; and food temperature measuring devices.

(98) "**Vending Machine**" is a self-service device that, upon insertion of a coin, paper currency, token, card, or key, dispenses unit servings of food in bulk or in packages without the necessity of replenishing the device between each vending operation.

(99) "**Vending Machine Location**" is the room, enclosure, space, or area where one or more vending machines are installed and operated and includes the storage and servicing areas on the premises that are used to service and maintain the vending machines.

(100) "**Ware Washing**" is the cleaning and sanitizing of food contact surfaces of equipment and utensils.

(101) "**Water Activity (a_w)**" is a measure of the free moisture in a food, is the quotient of the water vapor pressure of the substance divided by the vapor pressure of pure water at the same temperature, and is indicated by the symbol a_W.

1-4 RESPONSIBILITIES

1-4.1 Chief, Bureau of Medicine & Surgery (CHBUMED)

Establishes sanitary standards for food procurement, inspection on delivery, fitness for human consumption, storage and refrigeration, preparation and serving, and disposal of food residues. In addition, CHBUMED reviews and approves the sanitary aspects of standards, specifications, and design criteria prepared by other systems commands.

1-4.2 Naval Medical Treatment Facilities (MTFs)

Naval hospitals and clinics, through their preventive medicine departments, provide environmental health services intended to reduce the risk of food borne disease outbreaks including regular food service sanitation inspections and training. In addition, they conduct epidemiological investigations in the event of food borne outbreaks.

1-4.3 Navy Environmental and Preventive Medicine Units and Navy Environmental Health Center

Navy Environmental and Preventive Medicine Units(NAVENPVNTMEDUs), under the command of the Navy Environmental Health Center (NAVENVIRHLTHCEN), provide specialized consultation, advice, and recommendations in matters of preventive medicine and environmental health to Navy and Marine Corps activities, ashore and afloat. Services related to food safety include:

a. Food sanitation/safety instructor training programs;

b. Evaluation of food sanitation/safety programs;

c. Survey and recommendations concerning insect and vector problems;

d. Laboratory services;

e. Epidemiological investigation of food borne illness.

1-4.4 Commander, Naval Facilities Engineering Command

The Commander, Naval Facilities Engineering Command (COMNAVFACENGCOM) is responsible for the planning, design, and construction of public works at all shore activities, including messing and supporting facilities. COMNAVFACENGCOM also establishes inspection and maintenance standards. See Naval Facilities Engineering Command Modification Order (NAVFAC MO) 322, "Inspection for Public Works and Public Utilities," and NAVFAC MO-119, "Building Maintenance Galley Equipment."

1-4.5 Commander, Naval Sea Systems Command

The Commander, Naval Sea Systems Command is responsible for the design, construction and maintenance of messing facilities afloat. Structural standards are found in Naval Sea Systems Command (NAVSEA) S9AAO-AA-SPN-010/GEN-SPEC, "General Specifications for Ships of the United States Navy." Equipment standards are contained in the Naval Ships Technical Manual, Chapter 9340 (NSTM 9340), "Commissary Equipment."

1-4.6 Commander, Naval Supply Systems Command

The Commander, Naval Supply Systems Command (COMNAVSUPSYSCOM) administers the Navy Food Service Program.

a. The Deputy Commander for Support Services administers the subsistence program for the Navy. NAVSUP PUB 486 gives line of authority and direction for general mess operation.

b. COMNAVSUPSYSCOM (Code 51) has been delegated the responsibility for preparation of food service equipment specifications and has been tasked with the design of food service systems ashore and afloat.

(1) Navy Food Management Teams. Under the management of COMNAVSUPSYSCOM (Code 51), Navy Food Management Teams are composed of traveling instructors devoted to training food service personnel and assisting ships and field activities in improving the general messes. A preventive medicine technician (PMT) serves as a member of each team.

(2) Commands may obtain the services of these teams by submitting a request to COMNAVSUPSYSCOM (Code 51). Request procedures are located in NAVSUP PUB 486, Volume 1, Appendix J.

1-4.7 Commandant of the Marine Corps

a. The Commandant of the Marine Corps (CMC) administers the food service program for the Marine Corps which includes the procurement, storage, issue, accounting for the preparation, and serving of food in appropriated fund messing facilities.

b. Food Management Team, U.S. Marine Corps. The mission of the food management team is to render assistance in raising food quality, achieving economy, and increasing effectiveness at the various activities visited.

c. Information concerning the Food Service and Subsistence Management Programs within the Marine Corps may be found in Marine Corps Order P10110.14, "Food Service and Subsistence Management Manual."

1-4.8 U.S. Army Veterinary Services

As DoD Executive Agent for veterinary services, the U.S. Army Veterinary Service is responsible for all aspects of military veterinary medicine, to include food wholesomeness and food safety assurance mission. Regional veterinary service support commands are responsible for the development of a product verification program that will ensure the quality of food ordered at the food establishment. This program includes cursory spot checks, specific product audits, and special audits directed by Defense Personnel Support Activity (DPSA) or at the customer's request. Veterinary services should be utilized to the fullest extent possible by all Navy and Marine Corps food establishments. Services available are:

a. Training of ordering activity (receiving) personnel in evaluating food products at receipt, to include delivery vehicle sanitation and specific commodity knowledge.

b. Laboratory examination of food products.

c. Development of the approved lists of food suppliers and the publication of the "Directory of Sanitarily Approved Food Establishments for Armed Forces Procurement."

1-4.9 Commanding Officers

1-4.9.1 Introduction

Each commanding officer has the ultimate responsibility for ensuring food and beverages served within their jurisdiction are safe and wholesome. Guidance and support regarding sanitary food preparation, however, must be provided by the supply and medical departments.

1-4.9.2 Supply Officer

The supply officer is responsible for procurement, receipt, inspection, storage, and issue of food items.

1-4.9.3 Food Service Officer

The food service officer is in direct charge of the food service division in a command and is responsible for the preparation, serving, and storage of food.

1-4.9.4 Preventive Medicine Authority (PMA)

The PMA is responsible for the following:

a. Routine inspection of all food establishments including:

(1) Surveillance to ensure sanitary storage, preparation, and serving of food, and for the disposal of food wastes;

(2) Sanitation surveillance of food service spaces and cleaning of equipment and utensils;

b. Sanitation inspection of Navy and Marine Corps exchange food outlets, e.g., restaurants, cafeterias, snack bars, auxiliary resale outlets, etc;

c. Fitness for human consumption inspections to ensure food items are received from approved sources;

d. Medical screening of food service personnel for disease or unclean habits;

e. The provision of food service sanitation training programs;

f. Review of local plans and design specifications relating to construction of new food establishments and renovation of existing facilities;

g. Pre-operational inspections conducted on all new food establishments;

h. Maintaining regular liaison with the U.S. Army Veterinary Services to ensure adequate services are provided.

i. In the absence of U.S. Army Veterinary Inspectors the PMA is responsible for sanitary inspections of Navy and Marine Corps commissaries.

j. Epidemiological investigations in the event of food borne outbreaks.

1-4.9.5 Person in Charge

The food establishment manager shall be the person in charge or shall designate a person in charge. In military galleys the food service officer or leading mess management specialist/cook shall normally be the person in charge. A person in charge shall be required on site as specified in Section 2-1.1 of this chapter. See Section 2-1 for more details on the person in charge.

Section II. MANAGEMENT AND PERSONNEL

2-1 SUPERVISION

2-1.1 Responsibility (Assignment)

The food establishment manager/permit holder shall be the person in charge or shall designate a person in charge and ensure that a person in charge is present at the food establishment during all hours of operation for food facilities that are categorized as a risk type 3 or 4. Smaller food establishments that are categorized as a Risk Type 1 or 2 require one designated person in charge of the facility. Refer to Section 6-3.4 for explanations of risk categorization of food establishments.

2-1.2 Knowledge and Training

2-1.2.1 Knowledge Demonstration

2-1.2.1.A Person in Charge

Based on the risks of food borne illness inherent to the food operation, during inspections and upon request, the person in charge shall demonstrate to the preventive medicine authority knowledge of food borne disease prevention, application of the hazard analysis critical control point principles, and the requirements of the NAVMED P-5010-1, as it relates to the food operation, by:

a. Describing the relationship between the prevention of food borne disease and the personal hygiene of a food employee;

b. Explaining the responsibility of the person in charge for preventing the transmission of food borne disease by a food employee who has a disease or medical condition that may cause food borne disease;

c. Describing diseases that are transmissible through food and the symptoms associated with the diseases;

d. Explaining the significance of the relationship between maintaining the time and temperature of potentially hazardous food and the prevention of food borne illness;

e. Explaining the hazards involved in the consumption of raw or undercooked meat, poultry, eggs, and fish.

f. Stating the required food temperatures and times for safe cooking of potentially hazardous food, including meat, poultry, eggs, and fish;

g. Stating the required temperatures and times for the safe refrigerated storage, hot holding, cooling, and reheating of potentially hazardous food;

h. Describing the relationship between the prevention of food borne illness and the management and control of the following:

(1) Cross contamination,

(2) Hand contact with ready-to-eat foods,

(3) Hand washing, and

(4) Maintaining the food establishment in a clean condition and in good repair;

i. Explaining the relationship between food safety and providing equipment that is:

(1) Sufficient in number and capacity, and

(2) Properly designed, constructed, located, installed, operated, maintained, and cleaned;

j. Explaining correct procedures for cleaning and sanitizing utensils and food contact surfaces of equipment;

k. Identifying the source of water used and measures taken to ensure it remains protected from contamination such as providing protection from backflow and precluding the creation of cross connections;

l. Identifying poisonous or toxic materials in the food establishment and the procedures necessary to ensure they are safely stored, dispensed, used, and disposed of according to current regulations;

m. Identifying critical control points in the operation; from purchasing through sale or service, that may contribute to food borne illness and explaining steps taken to ensure that the points are controlled by the requirements of this manual;

n. Explaining the details of how the person in charge and food employees comply with a HACCP plan, if a plan is required by current regulations, or an agreement between the regulatory authority and the establishment, and

o. Explaining the responsibilities, rights, and authorities assigned by this chapter to the:

(1) Food employee,

(2) Person in charge, and

(3) Preventive medicine authority (PMA)/regulatory authority.

2-1.2.1.B Food Employee

Based on the risks of food borne illness inherent to the food operation, during inspections and upon request, the employees shall demonstrate to the regulatory authority knowledge of food borne disease prevention, application of the hazard analysis critical control point principles, and the requirements of the NAVMED P-5010-1, as it relates to the food operation, by:

a. Describing the relationship between the prevention of food borne disease and the personal hygiene of a food employee;

b. Explaining the significance of the relationship between maintaining the time and temperature of potentially hazardous food and the prevention of food borne illness;

c. Stating the required temperatures and times for the safe refrigerated storage, hot holding, cooling, and reheating of potentially hazardous food; and

d. Explaining correct procedures for cleaning and sanitizing utensils and food contact surfaces of equipment.

2-1.2.2 Training Requirements

2-1.2.2.A Person in Charge
2-1.2.2.B Food Employee
2-1.2.2.C Food Employee Training Course
2-1.2.2.D Supervisor/Manager Training Course

2-1.2.2.A Person in Charge

An 18-hour supervisor/manager food service sanitation/food safety training course is required for all personnel designated as a person in charge. This training is required for new personnel prior to assuming the responsibilities as a person in charge. A refresher supervisor/manager course is required every 3 years. The supervisor/manager food service sanitation training course also certifies supervisors/managers to teach the 4-hour employee food safety course.

2-1.2.2.B Food Employee

a. All food service employees must receive a minimum of 4 hours initial food safety training. New food service personnel shall receive this 4 hours training within the first 30 days of employment. All food service employees must receive a minimum additional 4 hours annual food sanitation training. This requirement for annual training need not be conducted in a consecutive 4 hour block of time.

b. Temporary food service personnel assigned for 30 days or less must receive 2 hours initial training and orientation. Personnel assigned in excess of 30 days must receive the minimum 4 hours training required of food service personnel.

c. Bartenders that do not prepare food require 1 hour of initial food sanitation training.

2-1.2.2.C Food Employee Training Course

a. Food safety training must be offered per SECNAVINST 4061.1 series and if approved by the area PMA, other programs (such as the National Restaurant Association, ServSafe® Courses or the Educational Testing Service Program) that meet the competency based requirements can be substituted. All training programs must be conducted by qualified food sanitation/safety instructors. Qualified food sanitation/safety instructors are:

(1) Independent duty Navy hospital corpsmen (must requalify every 3 years);

(2) Preventive medicine technicians;

(3) Environmental health officers;

(4) Personnel who supervise or train food service personnel and are successful graduates of a supervisor/manager food safety training course approved by the PMA (must re-qualify every 3 years).

b. Navy and Marine Corps food management teams may conduct food service sanitation training during official visits to commands provided the instructors are certified as required by SECNAVINST 4061.1 series.

c. The 4-hour employee food safety training course shall include the following topics.

(1) This course shall be based on the competencies listed in section 2-1.2.1.B of this chapter and consists of the following required topics.

(2) Topics:

(a) Personal Hygiene/Health Requirements

(b) Using Thermometers and Keeping Temperature Logs

(c) Inspection and Storage of Food

(d) Food Preparation and Serving

(e) Cleaning & Sanitizing

d. A separate Food Safety Training Certificate (NAVMED 4061/1) for each food employee, supervisor, and person in charge must be kept on file by the person in charge at the work location. Certificates will not be held by individual personnel except on the occasion of transfer or dismissal. These certificates must be verified by supervisory personnel and the PMA during routine sanitation inspections.

2-1.2.2.D Supervisor/Manager Training Course

a. Food service sanitation/food safety training must be offered per SECNAVINST 4061.1 series and if approved by the area PMA, other programs (such as the National Restaurant Association, Serving Safe Food/Applied Food Service Sanitation ServSafe® Courses or the Educational Testing Service Program) that meet the competency based requirements can be substituted. All training programs must be conducted by qualified food sanitation instructors. Instructors qualified to teach the food safety training for managers and supervisors are:

(1) Environmental health officers;

(2) Preventive medicine technicians;

(3) Other military and civilian personnel who are approved by the cognizant NAVENPVNTMEDU.

b. The 18-hour supervisor/manager food service sanitation/food safety training course shall include the following:

(1) This course shall be based on the competencies listed in section 2-1.2.1.A of this chapter and consists of the following:

(2) Topics:

(a) Administrative/Distribution of Materials

(b) Microbiology and Food borne Illness

(c) Personal Hygiene/Health Requirements

(d) Food Preparation and Serving

(e) Hazard Analysis of Critical Control Points (HACCP)

(f) Inspection and Storage of Food

(g) Ware Washing

(h) Pest Control in Food Service Areas

(i) Cleaning & Sanitizing of Food Service Equipment Safety

(j) Instructor Techniques

c. A refresher supervisor/manager food service sanitation/ safety training course is required every three years. The content and time requirements shall be under the direction of the area PMA.

d. Authority to teach the supervisor/manager food service sanitation training/refresher course resides with the area Environmental Health Officer (EHO) under the direction of the cognizant NAVENPVNTMEDU. Other organizations may request this authority by applying to the Navy Environmental Health Center (ATTN: Director for Preventive Medicine).

e. Instructors responsible for providing the supervisor/manager food service sanitation/safety training course have no specific "refresher course" requirements, but must maintain current knowledge of food service sanitation through continuing professional education.

2-1.3 Duties (Person in Charge)

The person in charge shall ensure that:

a. Food establishment operations are not conducted in a private home or in a room used as living or sleeping quarters.

b. Persons unnecessary to the food establishment operation are not allowed in the food preparation, food storage, or ware washing areas. Brief visits and tours may be authorized by the person in charge if steps are taken to ensure that exposed food, clean equipment, utensils, linens, unwrapped single service and single use articles are protected from contamination.

c. Employees and other persons such as delivery and maintenance persons and pesticide applicators entering the food preparation, food storage, and ware washing areas must comply with the provisions of this chapter.

d. Employees are effectively cleaning their hands, by routinely monitoring the employees' hand washing practices.

e. Employees are wearing clean outer clothing as specified in section 2-3.4 through daily visual inspection.

f. Employees are visibly observing foods as they are received to determine they are from approved sources, delivered at the required temperatures, protected from contamination, unadulterated, and accurately presented, by routinely monitoring the employees' observations and periodically evaluating foods upon their receipt.

g. Employees are properly cooking potentially hazardous food, being particularly careful in cooking those foods known to cause severe food borne illness and death, such as eggs and comminuted meats, through daily oversight of the employees' routine monitoring of the cooking temperatures

h. Employees are using proper methods to rapidly cool potentially hazardous foods that are not held hot or are not for consumption within 4 hours, through daily oversight of the employees' routine monitoring of food temperatures during cooling.

i. Consumers who order raw or partially cooked foods of animal origin are informed the food is not cooked sufficiently to ensure its safety.

j. Employees are properly sanitizing cleaned multiuse equipment and utensils before they are reused, through routine monitoring of solution temperature and exposure time for hot water sanitizing, and chemical concentration, pH, temperature, and exposure time for chemical sanitizing.

k. Consumers are notified that clean tableware is to be used when they return to self-service areas such as salad bars and buffets.

2-2 EMPLOYEE HEALTH

2-2.1 DISEASE OR MEDICAL CONDITION
2-2.2 PHYSICAL EXAMINATION (MEDICAL SCREENING)
2-2.3 EXCLUSIONS AND RESTRICTIONS
2-2.4 REMOVAL OF EXCLUSIONS AND RESTRICTIONS
2-2.5 PERSON IN CHARGE RESPONSIBILITIES
2-2.6 EMPLOYEE RESPONSIBILITIES

2-2.1 Disease or Medical Condition

2-2.1.1 Prohibited Diseases
2-2.1.2 Prohibited Symptoms

2-2.1.1 Prohibited Diseases

Prohibited diseases include illnesses caused by:

a. *Salmonella typhi*

b. *Shigella* spp.

c. *Escherichia coli* 0157:H7

d. *Hepatitis A* virus

2-2.1.2 Prohibited Symptoms

Prohibited symptoms caused by illness, infection, or other source that is:

a. Associated with an acute gastrointestinal illness such as:

(1) Diarrhea

(2) Fever

(3) Vomiting

(4) Jaundice

(5) Sore throat with fever

b. A lesion containing pus such as a boil or infected wound that is open or draining and is:

(1) On the hands or wrists, unless an impermeable cover such as a finger cot or stall protects the lesion and a single use glove is worn over the impermeable cover, and approved by the PMA.

(2) On exposed portions of the arms, unless the lesion is covered by a dry, durable, tight fitting bandage, and approved by the PMA.

2-2.2 Physical Examination (Medical Screening)

All food employees shall be medically screened for evidence of communicable disease prior to initial assignment in food service. The health screening does not normally include a physical examination but shall be sufficient to detect evidence of diseases that may be transmitted by food. Subsequent health screening (e.g., annual evaluation) is not routinely required. The health screening may be conducted by a physician or a non-physician health care provider, e.g., environmental health officer, nurse corps officer, preventive medicine technician, independent duty hospital corpsman, civilian nurse and civilian environmental health technician. Civilian food employees may be screened by local military medical facilities or they must present documentary evidence, acceptable to the local medical authority, that a complete and thorough health screening has been accomplished. All screening shall be documented using a locally prepared special Standard Form 600, which shall be reviewed by the local medical authority. An example of this form is found in Appendix C.

2-2.3 Exclusions and Restrictions.

The local medical authority shall:

a. Exclude a food employee from a food establishment if the employee is diagnosed with an infectious agent specified in 2-2.1.1.

b. Restrict a food employee from working with exposed food clean equipment, utensils, and linens; and unwrapped single service and single use articles, in a food establishment if the food employee is:

(1) Suffering from a prohibited symptom specified in Section 2-2.1.2, or

(2) Is not experiencing a symptom of acute gastroenteritis specified in Section 2-2.1.2 but has a stool that yields a specimen culture that is positive for *Salmonella typhi, Shigella* spp., *Escherichia coli* O157:H7, or hepatitis A virus.

c. If the population served is a highly susceptible population, exclude a food employee who has symptoms specified in Section 2-2.1.2 or meets one or more of the following high risk conditions:

(1) Is suspected of causing, or being exposed to a confirmed disease outbreak caused by *S. typhi*, *Shigella* spp., *E. coli* O157:H7, or hepatitis A virus illness or

(2) Lives in the same household as a person who is diagnosed with a disease caused by *S. typhi*, *Shigella* spp., *E. coli* O157:H7, or hepatitis A virus infection,

(3) Lives in the same household as a person who attends or works in a setting where there is a confirmed disease outbreak caused by *S. typhi*. *Shigella spp.*, *E. coli* O157:H7, or hepatitis A virus infection,

(4) Traveled out of the country within the last 50 calendar days.

2-2.4 Removal of Exclusions and Restrictions

The person in charge may reinstate an excluded food employee if the person in charge obtains approval from the local medical authority. The employee must provide written medical documentation from a physician licensed to practice medicine or the local military medical authority. The documentation must specify the excluded employee may work in an unrestricted capacity in a food establishment because the employee is free of the infectious agent of concern.

2-2.5 Person in Charge Responsibilities

2-2.5.1 Requirements for Initial Physical Examinations (Medical Screening) of All Food Employees or Applicants

The person in charge shall refer all food employees or applicants to the local medical authority for a physical examination (medical screening) prior to employment.

2-2.5.2 Requirements for Reporting of Active Disease Symptoms of All Food Employees or Applicants

The person in charge shall refer all food employees or applicants to the local medical authority or a licensed physician if the food employee or applicant has any symptoms or has been diagnosed with any diseases listed in this section. The person in charge shall not allow food employees or applicants to work until they have a written medical release from the local medical authority or a licensed physician.

2-2.6 Employee Responsibilities

All food employees or applicants shall report to the person in charge or to the local medical authority if the food employee or applicant has any symptoms or has been diagnosed with any diseases listed in this section. These food employees or applicants shall refrain from working until they have a written medical release from the local medical authority or a licensed physician.

2-3 PERSONAL CLEANLINESS

2-3.1 Hands And Arms

2-3.1.1 Clean Condition

Food employees shall keep their hands and exposed portions of their arms clean.

2-3.1.2 Cleaning Procedure

Food employees shall clean their hands and exposed portions of their arms with a cleaning compound by vigorously rubbing together the surfaces of their lathered hands and arms for at least 20 seconds and thoroughly rinsing with clean water. Employees shall pay particular attention to the areas underneath the fingernails and between the fingers.

2-3.1.3 When to Wash

Food employees shall clean their hands and exposed portions of their arms as noted above at the following times:

a. After touching bare human body parts other than clean hands, and clean exposed portions of arms;

b. After using the toilet room;

c. After caring for or handling authorized support animals;

d. After coughing, sneezing, using a handkerchief or disposable tissue, using tobacco, eating, or drinking;

e. After handling soiled equipment or utensils;

f. Immediately before engaging in food preparation including working with exposed food, clean equipment and utensils, and unwrapped single service and single use articles;

g. During food preparation, as often as necessary to remove soil and contamination and to prevent cross contamination when changing tasks;

h. When switching between working with raw foods and working with ready to eat foods;

i. After engaging in other activities that contaminate the hands.

2-3.1.4 Where to Wash

a. Food employees shall clean their hands in a hand washing lavatory when available and should not clean their hands in a sink used for food preparation, in a service sink, or in a curbed cleaning facility used for the disposal of mop water and similar liquid waste unless no other facilities are available.

b. Conspicuous signs requiring hand washing must be posted in food service and toilet areas.

2-3.1.5 Hand Sanitizers

Hand sanitizers may be used in addition to regular hand washing. Consult the PMA for guidance concerning the use of hand sanitizers.

2-3.2 Fingernails

Food employees shall keep their fingernails trimmed short, filed, and maintained so the edges and surfaces are cleanable and not rough.

2-3.3 Jewelry

While preparing food, food employees may not wear jewelry on their arms and hands. This section does not apply to a plain ring such as a wedding band.

2-3.4 Outer Clothing

Food employees shall wear clean outer clothing. When moving from a raw food operation to a ready-to-eat food operation, food employees shall wear a clean outer covering over clothing or change to clean clothing if their clothing is soiled.

2-3.5 Personal Effects

Clothing and personal effects of food service personnel must not be kept in food preparation and serving areas; nor will personnel use these same areas for changing their clothes.

2-4 HYGIENIC PRACTICES

2-4.1 Food Contamination Prevention

2-4.1.1 Eating, Drinking, or Using Tobacco

a. An employee shall not eat, drink, or use any form of tobacco except in designated areas, or as specified in paragraph b of this section. This policy should be particularly enforced where the contamination of any of the following may occur: exposed food; clean equipment, utensils, and linens; unwrapped single service and single use articles; or other items needing protection.

b. A food employee may drink from a closed beverage container if the container is handled to prevent contamination of:

(1) The employee's hands;

(2) The container;

(3) Exposed food; clean equipment, utensils, and linens; and unwrapped single service and single use articles.

2-4.1.2 Discharges from the Eyes, Nose, and Mouth

Food employees experiencing persistent sneezing, coughing, or a runny nose that causes discharges from the eyes, nose, or mouth may not work with exposed food; clean equipment, utensils, and linens; or unwrapped single service or single use articles.

2-4.2 Hair Restraints (Effectiveness)

a. Except as provided under paragraph b of this section, food employees shall wear hair restraints such as washable or disposable hats, hair coverings or nets, beard restraints, and clothing that covers body hair, that are designed and worn to effectively keep their hair from contacting exposed food; clean equipment, utensils, and linens; and unwrapped single service and single use articles. Washable hats shall be laundered regularly.

b. This section does not apply to food employees such as counter staff who only serve beverages and wrapped or packaged foods. Hostesses and wait staff present a minimal risk of contaminating exposed food, clean equipment, utensils, linens, and unwrapped single service and single use articles.

2-4.3 Animals

a. Food employees may care for their support animals if they wash their hands as specified in section 2-3.1.3 before working with exposed food; clean equipment, utensils, and linens; or unwrapped single service and single use articles. Support animals are only allowed in areas that are not used for food preparation.

b. Edible fish or decorative fish in aquariums, shellfish or crustacean on ice or under refrigeration, and shellfish and crustacean in display tanks are authorized.

c. Live animals must not be permitted in food establishments, except:

(1) Edible fish or decorative fish in aquariums, shellfish or crustacea on ice or under refrigeration, or shellfish and crustacea in display tank systems are allowed.

(2) Working dogs accompanying security or police officers in offices and dining/sales and storage areas, sentry dogs running loose in outside fenced areas, or support animals accompanying persons in dining/sales areas are allowed.

Section III. FOOD

3-1 PROCUREMENT, ACCEPTANCE & INSPECTION OF FOOD ITEMS

3-1.1 Procurement of Food Items

a. The Subsistence Prime Vendor (SPV) Program is a major reengineering effort within the Department of Defense (Food Purchasing Procedures) whereby a single distributor serves as the major provider of product to various Federal customers within a geographical region or zone. Navy and Marine Corps dining facilities will no longer receive food items from Defense Logistics Agency(DLA) warehouses. The vendor supplies commercially available subsistence under a contractual agreement established by the Defense Personnel Support Activity (DPSC) - the lead agency for the SPV program. The SPV selected for each zone will deliver directly to dining facilities or a chosen location within 48 hours after ordering. The customer will select the number of deliveries and the day of the week deliveries should be made. At time of delivery, items are accepted or rejected by the ordering activity, rejections will be replaced by the SPV.

b. All food delivered by SPV to Navy and Marine corps will originate from facilities listed in the U.S. Army publication, *Directory of Sanitarily Approved Food Establishments*, or from one of the following establishments exempted from the listing:

(1) Establishments listed in USDA publication, *Meat and Poultry Inspection Directory*.

(2) Establishments listed in USDA publication, *List of Plants Operating Under USDA Poultry and Egg-grading and Egg Products Inspection Programs.*

(3) Establishments having a pasteurized milk compliance rating of 90 percent or higher, certified by a State Milk Sanitation Officer, and listed in the *Sanitation Compliance and Enforcement Ratings of Interstate Milk Shippers List* (IMSL). The IMSL is published quarterly by the U.S. Department of Health and Human Services; Public Health Service (PHS); FDA, Center for Food and Applied Nutrition, Office of Compliance, Division of Cooperative Programs, Milk Safety Branch.

(4) Establishments listed in the *Dairy Plants Surveyed and Approved for USDA Grading Service.*

(5) Fish establishments listed in Parts I, II, and III of the United States Department of Commerce (USDC) *Approved List of Fish Establishments and Products* published by the USDC, National Oceanic and Atmospheric Administration and the National Fisheries Service.

(6) Shellfish establishments listed in *Interstate Certified Shellfish Shippers List,* published monthly by the U.S. Department of Health and Human Services, Food and Drug Administration, Washington, DC.

(7) The following establishments are also exempt from the *Directory of Sanitarily Approved Food Establishments* listing:

(a) Food imported by distributors or brokers into the United States.

(b) Plants located in the United States that process food known to possess little or no potential health hazards. Specific exemptions from the directory listing of other plants are on an item by item basis. See Naval Supply Systems Command Instruction 4355.4 /AR 40-657/MCO P10110.31

3-1.2 Acceptance Authority

3-1.2.1 General Information
3-1.2.2 Meats and Poultry
3-1.2.3 Fish and Shellfish (seafood)
3-1.2.4 Fruits and Vegetables
3-1.2.5 Canned Products
3-1.2.6 Dry Food Items
3-1.2.7 Milk

3-1.2.8 Butter, Eggs and Cheese

3-1.2.1 General Information

a. Acceptance of supplies will be at the food establishment or at the delivery points chosen by the activity. The acceptance authority is assigned to the ordering activity. Each activity is responsible for accepting or rejecting supplies as they are received. The receiving official is the final authority on acceptance or rejection of product. The ordering activity shall designate, in writing, those individuals authorized to accept or reject supplies delivered under the Subsistence Prime Vendor Program.

b. Changes in procurement brought about by the SPV program will include greater efficiencies and better partnership with industry through such practices as just in time deliveries, best value contracting, shared production agreements and electronic data interchange. However, some of basic concepts have not changed. They are as follows:

(1) All foods delivered to Navy and Marine Corps food establishments will originate from approved food establishments. See section 3-1.1b.

(2) Deliveries made under SPV do not need to be inspected by the Army Veterinary Inspector or the PMA prior to being accepted. (NOTE): Suspected unwholesome products of any kind will not be accepted without the concurrence of the responsible PMA.

(3) Fitness for human consumption is still required on any local purchase food items not delivered by the SPV.

c. When deliveries are made to a Navy or Marine Corps food establishment by a subsistence prime vendor or a subcontractor under a prime vendor contract, inspection of delivery product by the PMA or Army veterinary personnel is not required. However, when requested by the food service officer or representative, the PMA will assist with any determination concerning food that is delivered deteriorated, contaminated, or infested.

d. Fitness for human consumption inspections must be conducted by the PMA both ashore and afloat. These inspections will be conducted only on locally purchased food items that were not obtained from an SPV and were not inspected by U.S. Army veterinary service personnel.

e. The PMA concerned with food inspections ashore should maintain liaison with local personnel of the U.S. Army veterinary services, USDA, and/or USDC inspectors to avail themselves of general information and techniques involved in food inspection.

f. Food inspections afloat should be made in the company of the supply officer or representative, thus a combination of knowledge and training can result in an effective inspection program.

g. The practice of sound judgement, coupled with experience and common sense will help determine what items are fit or unfit. Foul odor and unnatural appearance, as determined by the PMA, are causes for rejection.

3-1.2.2 Meats and Poultry

a. In the United States all meat and poultry purchased from subsistence prime vendors or a subcontractor under a prime vendor contract must have originated from plants operating according to all USDA requirements and the law. In overseas areas where meats, meat products, poultry, and poultry products cannot be obtained from plants under Federal or State inspection systems, the U.S. Army Veterinary Service provides inspection services. These approved plants are listed in the *Directory of Sanitarily Approved Food Establishments.*

b. Guidelines for receipt of meats and poultry may be found in NAVSUP PUB 421 AND NAVSUP PUB 486.

3-1.2.3 Fish and Shellfish (seafood)

a. Fish may not be received from subsistence prime vendors Unless they are legally caught, harvested, and obtained from a source listed in *Directory of Sanitarily Approved Food Establishments or USDC Approved List of Fish Establishments and Products.*

b. Fish must be carefully inspected. Refrozen fish must not be used. Fresh fish have bright red gills, prominent clear eyes and firm elastic flesh. Stale fish are dull in appearance, have cloudy and red bordered eyes and soft flesh; finger impressions are made easily and remain when digital pressure is released.

c. Fish caught over the side at sea must not be consumed.

3-1.2.4 Fruits and Vegetables

Inspections of fresh fruits and vegetables are based on USDA standards. Use common sense when inspecting fruits and vegetables. For additional information refer to NAVSUP 421.

3-1.2.5 Canned Products

a. Foods in hermetically sealed containers shall be obtained from an approved source. The use of home canned foods is prohibited.

b. Canned foods shall be inspected upon delivery. Do not accept defective canned goods.

c. Do not serve food from cans with abnormal odor, taste or appearance, or from containers showing abnormalities such as dented seams, bulging, swelling or leakage and rusting - particularly at the seams. Identify suspect canned foods, set them aside and hold for inspection by the PMA or the veterinary service.

3-1.2.6 Dry Food Items

a. Dry food items, other than canned goods, include such foods as cereals, sugar, dried fruits/vegetables, flour and meal. They must be stored under controlled conditions of temperature, humidity and air circulation.

b. Insects, particularly cockroaches and stored products pests, are often transported from one location to another concealed among bulk food items such as potatoes and onions or in and on cartons used to hold other dry food items. Therefore, pierside inspection of these items is essential.

3-1.2.7 Milk

a. Only Grade A pasteurized fluid milk and fluid milk products from approved plants will be used or served. Manufactured milk products will meet applicable Federal standards for quality.

b. Dry milk and dry milk products will be made from pasteurized milk and milk products.

c. Milk and fluid milk products for drinking purposes will be procured and served in the original, unopened, individual container of one pint or less, packaged at the milk plant, or be procured in containers approved for use with bulk milk dispensers. The PMA may approve use of original one gallon containers.

(1) An exception is granted for child development center programs. At child development center programs, milk may be transferred from bulk milk dispensers, commercial one gallon or smaller containers to small, clean, sanitized serving pitchers.

The pitchers will be covered and transported immediately to child activity rooms. All milk remaining in the serving pitchers will be discarded.

d. Individual, single service, disposable containers of one pint or less will be used when fresh milk is served in flight, in transit, at field exercises, to patients in isolation for infectious or suspected infectious disease, or to individuals under similar conditions.

e. Milk and fluid milk products will not be offered for consumption beyond product expiration date without approval from the local veterinary activity.

f. Delivery inspections of dairy products are normally conducted by personnel attached to the receiving activity. Inspectors must ensure milk and milk products are from an approved source and delivered in containers which are in good condition, properly sealed, organoleptically acceptable, and that the temperature of the product on delivery is 45°F or less or under the current procurement contract.

g. Vehicles used in transportation of milk in its final delivery containers must be refrigerated, constructed with permanent tops and sides, and must be clean. The use of ice on tops of milk cartons for cooling milk during delivery or on the serving line is prohibited.

3-1.2.8 Butter, Eggs and Cheese

a. Butter. Butter should be received in clean, unbroken cases. The color should be uniform and the texture firm.

b. Shell Eggs.

(1) Shell eggs shall be received clean and sound and may not exceed the restricted egg tolerances for U.S. Consumer Grade B as specified in 7 CFR Part 56 - Regulations Governing the Grading of Shell Eggs and U.S. Standards, Grades, and Weight Classes for Shell Eggs, and 7 CFR Part 59 - Regulations Governing the Inspection of Eggs and Egg Products.

(2) Shell eggs must be received at 45° F or less and cooled and maintained at 41° F or below.

(3) Liquid, frozen, or dry eggs and egg products shall be obtained pasteurized.

c. Cheese may be received in either natural or processed form. The rind should be clean and free from mold or wrinkles. Moldy cheese must not be sold or served unless it has been reconditioned. Cheese is reconditioned when the following criteria are followed:

(1) If the cheese has been held at 41°F, a ½ inch layer is removed and the moldy portions are discarded.

(2) The cutting must be performed so that mold contamination of the new surfaces is prevented.

(3) Cheese with high moisture content (e.g., cream and cottage) or with mold filaments which deeply penetrate the surfaces, and cheese portions too small to be reconditioned, must be discarded.

(4) All cheese procured for use by the Navy and Marine Corps is manufactured and labeled as required by 21 CFR 133.

3-1.3 Inspection of Food Items

a. The U.S. Army Veterinary Inspector (AVI) and the Navy PMA will assume a new role in support of food inspection and the acceptance of subsistence delivered to DoD activities under the Subsistence Prime Vendor Program. AVIs perform three types of product compliance evaluations under prime vendor: cursory, routine, and special compliance evaluations. The basic concept of these inspections and the acceptance of food evaluations, are as follows:

(1) The person in charge or designated representative at the receiving activities are responsible and have the authority to accept or reject subsistence delivered under the Subsistence Prime Vendor Program. AVIs will not normally be available to perform a wholesomeness determination on every delivery nor will the Navy PMA be required to be present at time of delivery to determine wholesomeness. Day-to-day quality assurance is the responsibility of the ordering activity.

(2) The person in charge or designated representative must ensure that authorized receiving individuals conduct a sanitary inspection of the vehicle and determine the identity, quantity and condition on all items received. AVIs will perform random sampling, called "cursory product compliance evaluation" of deliveries to evaluate wholesomeness of subsistence.

(3) AVIs are responsible for providing timely wholesomeness determinations on food items delivered to or accepted at prime vendor delivery points (receiving activities).

AVIs will not impede deliveries to accommodate any product or any product evaluations unless they identify unwholesome products or unsanitary vehicle conditions.

(4) When products of questionable quality are identified prior to acceptance, authorized receiving individual's may request that AVIs or the Navy PMA provide guidance on or actually perform expedited product quality evaluations on deliveries.

(5) Routine Product Compliance Evaluations are performed to ensure food items comply with packaging and marking, best value for their intended use, satisfaction by customer, wholesomeness and at a minimum, count, condition and identity are determined. AVIs evaluate food products against applicable vendor specifications. Generally, cooking of product is not involved and the evaluation is done on-site at the food establishment. Items selected for Routine Compliance Evaluation are food items which have caused customer dissatisfaction.

(6) Special Product Compliance Evaluations are performed to ensure items meet **all** requirements in the specifications under which they were procured and they are wholesome. Special evaluations may involve cooking or other forms of processing and will be performed on-site at the food establishment by the AVI. However, food service authorities at any location may request evaluation of items other than or in addition to those scheduled for a Special Product Compliance Evaluation.

b. Inspection of food items conducted without the assistance of AVIs or the Navy PMA should be approached using common sense and knowledge obtained through food service sanitation training. If food has a foul odor or appears unnatural, it is cause for rejection and should be immediately reported through the chain of command.

3-1.4 Temperature Specifications for Receiving of Food Items

a. Except as specified in paragraph b of this section, refrigerated, PHF shall be at a temperature of 41°F (5°C) or below when received.

b. If a temperature other than 41°F (5°C) for a PHF is specified in the law(s) governing its distribution, such as laws governing milk, molluscan shellfish and shell eggs, the food may be received at the specified temperature.

c. PHF that is cooked to a temperature required by section 3-5 and received hot shall be maintained at a temperature of 140°F (60°C) or above.

d. A food that is labeled frozen and shipped frozen by a food processing plant shall be received frozen.

e. Upon receipt, PHF shall be free of evidence of previous temperature abuse.

3-2 PROTECTION OF FOOD ITEMS FROM CONTAMINATION AFTER RECEIVING

3-2.1 Preventing Contamination From Hands

a. Food employees shall wash their hands as specified under section 2-3.1.

b. Except when washing fruits and vegetables, food employees must not touch exposed, ready-to-eat food with their bare hands and shall use suitable utensils such as deli tissue, spatulas, tongs, single use gloves or other dispensing equipment to handle food products.

c. Food employees shall minimize bare hand and arm contact with exposed food that is not in a ready-to-eat form.

3-2.2 Preventing Contamination When Tasting

A food employee may not use a utensil more than once to taste food that is to be sold or served.

3-2.3 Packaged and Unpackaged Food - Separation, Packaging and Segregation

a. Food shall be protected from cross contamination by separating raw animal foods during storage, preparation, holding, and display from:

(1) Raw ready-to-eat food including raw animal food such as fish for sushi or molluscan shellfish, or other raw ready-to-eat food such as vegetables; and

(2) Cooked ready-to-eat food.

b. Except when combined as ingredients, separate types of raw animal foods from each other such as beef, fish, lamb, pork, and poultry during storage, preparation, holding, and display by:

(1) Using separate equipment for each food type; or

(2) Arranging each type of food in equipment so that cross contamination of one type with another is prevented; and

(3) Preparing each type of food at different times or in separate areas.

c. Cleaning equipment and utensils and sanitizing as specified in this chapter;

d. Storing food in packages, containers, or wrappings;

e. Cleaning hermetically sealed containers of food of visible soil before opening;

f. Protecting food containers that are received packaged together in a case or overwrap from cuts when the case or overwrap is opened;

g. Clearly distinguishing damaged, spoiled, or recalled food being held in the food establishment;

h. Separating fruits and vegetables, before they are washed.

3-2.4 Food Storage Containers, Labeled with Common Name of the Food

Containers holding food or food ingredients shall be labeled with the common name of the food. Containers holding food that can be readily and unmistakably recognized (e.g., dry pasta, bread) need not be identified.

3-2.5 Pasteurized Eggs, Substitute for Shell Eggs for Certain Recipes and Populations

Pasteurized liquid, frozen, or dry eggs or egg products shall be substituted for shell eggs in the preparation of:

a. Foods such as Caesar salad dressing, hollandaise or béarnaise sauce, mayonnaise, eggnog, ice cream, and egg-fortified beverages.

b. Eggs for a highly immunocompromised or otherwise susceptible population.

3-2.6 Washing Fruits and Vegetables

a. Raw fruits and vegetables shall be thoroughly washed in water to remove soil and other contaminants before being cut, combined with other ingredients, cooked, served, or offered for human consumption in ready-to-eat form.

b. Vegetables of uncertain origin and those purchased in foreign countries, as well as those suspected of being contaminated with pathogenic organisms, must be chemically disinfected by immersion for at least 15 minutes in a 100 ppm Free Available Chlorine(FAC) solution or for 30 minutes in a 50 ppm FAC solution (or other approved solution). Following disinfection, vegetables must be thoroughly rinsed with potable water before being cooked or served. A 100 ppm chlorine solution can be made by adding 3 tablespoons of 5% sodium hypochlorite to 5 gallons of water; use 1½ tablespoons for a 50 ppm solution. Head items such as lettuce, cabbage, celery, etc., must be broken apart before disinfection.

3-2.7 Ice used as Exterior Coolant is Prohibited from Reuse

Ice may not be used as food after it has been used as a medium for cooling the exterior surfaces of food such as melons or fish, packaged foods, canned beverages, or cooling coils and tubes of equipment.

3-2.8 Single use Gloves, used for one Purpose and Discarded

If used, single use gloves shall be used for only one task such as working with ready-to-eat food or with raw animal food, used for no other purpose, and discarded when damaged or soiled, or when interruptions occur in the operation.

3-3 DISPOSITION OF UNSATISFACTORY FOOD ITEMS

a. The discovery of a hazardous food item in a military food establishment will:

(1) Be reported by the person in charge by OP-IMMEDIATE message to the Defense Personnel Support Center, Philadelphia ATTN: DPSC-HQS (Consumer Safety Officer). The mailing address is 2800 South 20th Street, Philadelphia, PA 19145. Commercial telephone: (215) 737-3845; DSN: 444-3845; FAX: (215) 737-7526. Message plad is DPSC PHILADELPHIA PA.

(2) The person in charge shall place the item on medical hold and submit samples and tests of the suspected food as follows:

(a) Shore activities. Samples of the product (both normal and abnormal) will be submitted when considered necessary by the PMA or veterinary representative. Samples will be sent with an original and four copies of DD Form 1222, Request for Results of Tests.

(b) Ships. At the direction of the PMA, samples of the food product both normal and abnormal, will be turned into the nearest Navy shore activity which will arrange for veterinary inspection of the product as in section (a) above.

(c) Submit samples to one of the following addresses, as appropriate.

(d) Veterinary Laboratories:

CONUS:

DoD Veterinary Laboratory
2472 Schofield Road
Bldg 2632
Fort Sam Houston, TX 78234

Hawaii:

Veterinary Services, TAMC
ATTN: Food Analysis Laboratory
Bldg 936 Duck Road
Schofield Barracks, HI 96859-5460

Europe:

Veterinary Laboratory
Gebaube 3810
6790 Landstuhl Kirchberg Germany

Panama:

Veterinary Public Health Lab
Bldg 502
USAMEDDAC
APO AA34004-5003 Corazal Republic of Panama

b. NAVSUP Publication 486, Volume 1, Food Service Management-General Messes, provides a line-by-line procedure for the preparation, addressing, and information copies of the message and DD Form 1222.

c. Hazardous food items are products which would certainly or possibly cause, or suspected to have already caused, harm when consumed. Such items may be unfit for human consumption, suspected of being unfit for human consumption, or suspected to be the source of a food borne disease outbreak. Determination of "fitness for human consumption" is the responsibility of the PMA.

d. Examples of hazardous food items are:

(1) Widespread presence of swollen or leaking cans, (The contents of bulged or swollen cans should never be consumed or even tasted);

(2) Products with offensive or unusual odors and colors and/or any other evidence of deterioration, spoilage, or contamination. (Try to determine whether or not the hazardous condition is due to an isolated instance, excessive storage, or mishandling prior to reporting the item hazardous);

(3) Food items containing glass, dirt, pieces of metal, etc.

(4) Any apparently wholesome food items which, based on the best medical knowledge available, is suspected or known to harbor disease causing agents. (Food items which have become hazardous due to overage, mishandling while in the custody of the user, or other isolated instances of abuse will not be reported under these procedures).

(5) Infested with insects.

3-4 STORAGE AND CARE OF FOOD ITEMS

3-4.1 General Information

a. Proper food storage minimizes contamination and improves shelf life. Food, whether raw or prepared, if removed from the container or package in which it was obtained, shall be stored in a clean, covered container. Container covers shall be impervious and nonabsorbent, except clean linens or napkins may be used for covering small quantities of bread or rolls. Solid cuts of meat will be covered in storage, except that quarters or sides of meat may be hung uncovered on clean, sanitized hooks if no food product is stored beneath the meat. Where dissimilar species of raw meats or raw and cooked items are stored in the same refrigeration unit, physical separation or other effective product protection shall be provided to prevent cross contamination.

b. Containers or bulk lots of food will be stored 6 inches (15 cm) above the floor and 4 inches (10 cm) from the walls, on clean racks, dollies, non wood pallets, or other easily cleanable surfaces. Storage racks and dollies should be easily moveable to facilitate inspection and cleaning. Wood pallets must not be used for food storage.

c. Do not store food or clean equipment including single service utensils in locker areas, toilet rooms, open stairwells or vestibules, garbage rooms, or mechanical areas, including boiler, electrical or telephone control rooms and elevator shafts.

d. Do not store food or food containers under exposed or unprotected sewer lines, steam, water or waste lines or other pipes on which condensation forms, under leaking automatic fire sprinkler systems or other sources of contamination. (Note: In existing facilities violating this requirement, the PMA will determine the need for; drip pans or other shielding to intercept and direct potential dripping or condensate into a sanitary waste line, insulation, relocation, renovation of storage areas or other corrective action).

e. Food not subject to further washing or cooking before serving will be stored in a way that protects it against cross contamination. Separate refrigerated storage units should be used for raw meats and seafood. If a unit is used to store both raw and cooked foods, raw meats and fish should be covered and stored below any cooked foods, or foods such as salads, which will receive no cooking or reheating before serving.

f. Nonacidic bulk food, such as cooking oil, syrup, salt, sugar, or flour, should be stored in the original product package or container.

(1) If bulk packages of flour, sugar and similar items are open, store packages in containers with tight fitting lids that meet NSF International standards for food service. Label the container with the common name of the food. The plastic garbage bags available through the supply system generally do not meet requirements for food contact.

g. Do not use galvanized metal cans for storage of wet foods or beverages.

h. Only food items will be stored in food storage spaces.

3-4.2 Refrigerated Storage

a. Proper temperature control is the most effective means of minimizing the risk of food borne illness and reducing loss through spoilage. One "nonproduct" or built-in air measuring thermometer must be provided in all refrigerated storage spaces. Thermometers or air measuring devices must be readily observable, easily readable, numerically scaled, and accurate to $\pm 3°F$ at the critical range. Mercury thermometers are prohibited. The temperature sensor of the thermometer must be positioned to register the warmest air in the refrigerated space.

(1) To maintain product temperatures, check refrigerator temperature frequently, especially at times of peak load and low load. Make adjustments as required.

(2) Primary attention should be placed on monitoring product temperatures.

(3) Required temperature ranges are 32-41°F for refrigeration and 0°F or below for freezers.

(4) Frost or glaze ice must not be allowed to accumulate to more than 1/4 inch in thickness on the interior surfaces or on the refrigeration coils.

(5) The interior surfaces of refrigerated storage units must be routinely washed with warm water and hand ware washing detergent then rinsed with warm potable water.

(6) Temperature logs must be maintained for all bulk cold storage spaces. Accurate entries will be made at least twice daily. Any prolonged deviation (more than 4 hours) from the recommended storage temperatures must be promptly reported to the food service officer and PMA for appropriate action;

(7) Refrigerators that contain advance prepared PHF will also have temperatures logged twice daily. Logs must be maintained in the facility for at least 1 year.

b. PHF requiring refrigeration after preparation will be cooled to an internal product temperature of 41°F or below within 4 hours.

c. Frozen food will be kept frozen and stored at a product temperature of 0° F or below. Ice cream being dispensed by a scoop can be held between 6°F and 10°F to facilitate serving.

d. Wet storage of food is prohibited, except for short term holding (24-36 hours) of peeled or sliced potatoes, carrots, and celery sticks. Wet storage of live lobsters is authorized prior to preparation.

e. All food stored in refrigerated storage units will be covered or otherwise protected from contamination. See section 3-5.6 for cooling procedures.

f. Direct storage of raw or prepared foods, except for unpeeled hard skin fruits and vegetables, on refrigerator shelves is prohibited.

g. Foods protected in single shelf refrigerated display cases are not required to be individually covered.

3-4.3 Heated Storage

a. Provide sufficient conveniently located hot food holding units to assure the maintenance of food at the required temperature during holding. Each piece of equipment used for holding PHF will be provided with an easily readable numerically scaled indicating thermometer, accurate to ±3°F, located to measure the air temperature in the coolest part of the unit and placed to be easily readable. Recording thermometers, accurate ±3°F, may be used in lieu of indicating thermometers. Where it is impractical to install thermometers on equipment such as hot food tables, steam tables, steam kettles, heat lamps or insulated food transport carriers, a sanitized product thermometer will be available and used to check the internal product temperature of the food.

b. PHF that is cooked, cooled and reheated for hot food holding or transport shall be rapidly reheated, within 2 hours, so all parts of the food reach an internal product temperature of at least 165°F (74°C) for at least 15 seconds.

(1) Food reheated in a microwave shall be covered, rotated and stirred until the internal product temperature reaches 165°F, then it must remain covered for 2 minutes to obtain temperature equilibrium.

(2) Ready to eat food from a commercially processed, hermetically sealed container or packaging shall be heated to a temperature of at least 141°F for hot holding.

(3) Hot food holding containers shall be preheated to at least 145°F prior to placing hot food in the containers. Where possible, boiling water shall be used for preheating.

c. Steam tables, warmers, or other hot food storage units are not designed for rapid heating of PHF and shall not be used for heating food items.

3-4.4 Semi Perishable Food

a. The term "semiperishable" refers to food items that are canned, dried, dehydrated, or otherwise processed to the extent that such items, under normal circumstances, may be stored in nonrefrigerated spaces.

b. Semiperishable food items shall be considered overaged when stored in excess of the inspection test date marked on the case and/or the keeping time shown in the semiperishable food storage table of NAVSUP PUB 476, volume 1, chapter 5. The U.S. Army Veterinary Service, at stock points, inspects overaged food items and warehouse personnel mark the cases and/or the DD Form 1348-1 of those items that are in good condition to indicate the keeping time has been extended. Even when items are not so marked, they will be considered fit for use if the container is in good condition and the food item has no offensive odor and is palatable. Overaged items are not considered suitable for continued storage unless they have been extended by a qualified inspector. Extended food items must be consumed as soon as feasible. Items must not be surveyed solely because of age. Outdated food items will be surveyed only if a qualified inspector finds them to be unfit for human consumption.

c. When inspecting storerooms, the outward appearance of food containers and the condition of the foods must be checked. Torn or broken bags of food must be immediately used, transferred to insect proof containers or surveyed. If an insect infestation is discovered, several specimens should be carefully collected and sent for species identification to the nearest military activity capable of identifying insects. A report of suspected hazardous food items must be submitted as required by NAVSUP PUB 486, Volume 1.

d. Heavily infested food, i.e. seven or more living or dead insects per pound must be surveyed (see MIL-STD-904A). Lightly infested food should be immediately removed, placed in a freezer for 72 hours, sifted to remove the insects and used as soon as possible, except as follows:

(1) When an infestation is found to involve living or dead larval stages of an insect species belonging to the genus *Trogoderma*, or other dermestids, one insect within the product itself (not external) will be justification for the condemnation of the container or bag;

(2) When an infestation is found to involve living or dead insect species belonging to the genus *Tribolium*, three insects per pound within the packages inspected will be justification for the condemnation of the lot.

(3) When an infestation is found to involve insects other than those belonging to the genus *Trogoderma* (or other dermestids) or *Tribolium*, an average of seven or more insects per pound of product, in the lot being inspected, shall be justification for condemnation of that lot.

e. It is important to remember that 72 hours in a freezer will arrest the development of the infestation but will not kill all of the insects. To kill all insects in all stages, the infested product must be kept at 0°F or below for 2 weeks. When insect infestations are discovered, they must be handled by Chapter 8, Medical Entomology and Pest Control Technology, of this manual, NAVMED P-5010.

3-4.5 Fresh and Frozen Food

a. To promote proper air circulation, fresh and frozen food items must be stored on pallets or one inch high deck grating away from bulkheads and cooling coils. At least 6 inches of clearance must be maintained between the tops of the stacks and the openings of the air ducts.

b. Generally, when the recommended temperatures are uniform in all areas of the storage refrigerator or freezer, the air circulation is considered adequate.

3-4.6 Food Storage Procedures

a. Because age is a contributing factor in food spoilage, foods must be rotated so the oldest items are used first. Use the rule "first in first out" (FIFO). Adequate stock rotation reduces losses due to spoilage.

b. Only food items may be stored in food storage spaces, e.g., storerooms, refrigerators, reefers. On some classes of ships medical supplies may be stored in refrigerated food storage spaces if kept under lock and key and no other place is available.

c. Decayed or otherwise spoiled food items must be identified and removed from wholesome foods.

d. Foods which readily absorb foreign odors, such as eggs, fresh milk, and butter, must not be stored with fruits and vegetables.

e. Food or containers of food must not be stored close to steam pipes or other sources of heat which would reduce the shelf life of the product.

3-4.7 Ice

a. Commercially procured ice must be from a supplier listed in the Directory of Sanitarily Approved Food Establishments for Armed Forces Procurement. Ice intended for human consumption in food or drink shall be manufactured from potable water only. Ice used for cooling stored food and food containers will not be used for human consumption.

b. Ice machines must be located, installed, operated, and maintained in a sanitary manner to prevent contamination. They must be cleaned monthly or more often as required. See Table 1-1.

c. Ice buckets, other containers and scoops must be of smooth impervious material designed for easy cleaning. They shall be kept clean and stored and handled in a sanitary manner. Scoops shall be stored handle up in a freely draining metal bracket outside the ice storage compartment or in a metal bracket installed within the machine at such a height to preclude the scoop being covered by the ice.

d. Ice should be bacteriologically sampled as determined by the PMA.

Table 1-1. Directions for monthly cleaning of ice making machines

BULK ICE MAKING MACHINES

STEP	PROCEDURES
1. Turn off motor	Empty, defrost and clean. Make certain overflow pipes carry off water used for defrosting.
2. Wash all parts, including ice storage bin.	Use a plastic bristle brush to scrub inside and outside of bins with mild detergent solution.
3. Rinse	Rinse with water containing at least 50 ppm chlorine to preclude bad odors and the accumulation of film deposits from detergents. Water drain should be clear and free to allow proper rinse.
4. Check Water Control	Clean to prevent clogging of holes of water flow control.

ICE DISPENSING MACHINES
Cleaning instruments without unit disassembly

STEP	PROCEDURES
1. Shut off water.	Pour 1 qt. cleaning solution slowly into water reservoir.
2. Place a container below ice chute in bin and start ice machine.	Ice will be formed from cleaning solution. Discard ice. Shut off machine.
3. Flush ice making system	Add 1 qt. cleaning water to reservoir. Catch ice in a container. Discard.
4. Wash down storage bin with mild detergent solution. Rinse.	Scrub interior with a plastic brush and detergent solution. Thoroughly rinse with clean water.

3-4.8 Salvage of Food Exposed to Refrigeration Failure

Food that was exposed to refrigeration failure may be salvaged under proper conditions. The PMA or Army Veterinary Service should be contacted for assistance. Further guidelines may be obtained from the US Army Guide to the Salvage of Chilled/Frozen Foods Exposed to Refrigeration Failure.

3-5 PREPARING AND SERVING OF FOOD

CHAPTER 1, FOOD SAFETY

3-5.1 Introduction

a. All food (including ice) will be obtained from approved sources and will be wholesome, honestly presented and labeled per Federal law.

b. Food prepared in a private home may not be used or offered for human consumption in a food establishment. This requirement does not apply to chapel suppers, family child care homes, neighborhood cookouts, unit bake sales, and similar functions, provided the food is identified as home prepared food. Serving home canned foods is prohibited at command sponsored events.

c. Food Protection Measures. Minimum food protection measures include:

(1) Applying good sanitation practices in the handling of food.

(2) Maintaining high standards of personal hygiene.

(3) Keeping PHF refrigerated or heated to temperatures that minimize the growth of pathogenic microorganisms.

(4) Inspecting food products for wholesomeness, temperature, and sanitary condition prior to acceptance at the facility.

(5) Cooking potentially hazardous foods (PHFs), as appropriate, to kill harmful microorganisms.

(6) Providing adequate personnel, equipment, and facilities to ensure sanitary operation.

(7) Preventing infestation or contamination of food by insects and rodents, and contamination of food with toxic chemicals.

(8) Use properly designed, cleaned and sanitized equipment for its intended use.

3-5.2 Cooking Raw Animal Products

a. Except as specified in the paragraphs below, raw animal foods such as eggs, fish, poultry, meat (except roast beef), and foods containing these raw animal foods, shall be cooked to heat all parts of the food to an internal temperatures as identified in Table 1-2:

(1) Poultry, poultry stuffing, stuffed meats, stuffed fish or stuffing containing fish, meat or poultry shall be cooked immediately after preparation and without interruption to heat all parts to a minimum internal product temperature of 165°F (74°C) for 15 seconds.

(a) Poultry may be stuffed, but the internal temperature of the stuffing must reach 165°F. Stuffing must be removed from the bird immediately and stored at 140°F or above until served. It is not recommended to stuff multiple birds for a large meal. Stuffing for large meals should be prepared separately.

(2) Pork, game animals, comminuted fish and meats, injected meats and eggs that are not cooked to order shall be cooked to meet one of the time temperature combinations shown in Table 1-2 below:

TABLE 1-2. Minimum cooking time and temperature combinations for pork, game animals, comminuted fish and meats, injected meats and eggs that are not cooked to order.

Minimum Internal Product Temperatures	Time
145°F (63°C)	3 minutes
150°F (66°C)	1 minute
155°F (68°C)	15 seconds

(3) Ground beef should be cooked to a minimum internal temperature of 155°F for 15 seconds or until juices run clear.

(4) Whole beef roasts and corned beef roasts shall be cooked in an oven that is preheated to the temperature specified in table 1-3 and is held at or above that temperature; and to a food temperature as specified in table 1-4 for the corresponding amount of time for that temperature.

Table 1-3. Oven parameters required for destruction of pathogens on the surface of roasts of beef and corned beef.

Oven Type	Oven Temperature Based on Roast Weight	
	Less than 10 lbs (4.5 kg)	10 lbs (4.5 kg) or greater
Still Dry	350°F (177°C) or greater	250°F (121°C) or greater
Convection	325°F (163°C) or greater	250°F (121°C) or greater
High Humidity[1]	250°F (121°C) or less	250°F (121°C) or greater

[1]Relative humidity greater than 90% for at least 1 hour as measured in the cooking chamber or exit of the oven; or in a moisture impermeable bag that provides 100% humidity.

Table 1-4. Minimum holding times required at specified temperatures for cooking all parts of roasts of beef and corned beef.

Temperature °F (°C)	Time[1]	Temperature °F (°C)	Time[1]	Temperature °F (°C)	Time[1]
54 (130)	121 minutes	58 (136)	32 minutes	61 (142)	8 minutes
56 (132)	77 minutes	59 (138)	19 minutes	62 (144)	5 minutes
57 (134)	47 minutes	60 (140)	12 minutes	63 (145)	3 minutes

[1]Holding time may include post oven heat rise.

b. Microwave Cooking

(1) Raw animal foods cooked in a microwave oven shall be:

(a) Rotated or stirred throughout or midway during cooking to compensate for uneven distribution of heat;

(b) Covered to retain surface moisture;

(c) Heated to a temperature of at least 165°F (74°C); in all parts of the food;

(d) Allowed to stand covered for 2 minutes after cooking to obtain temperature equilibrium.

c. Raw, marinated, or partially cooked fish (other than molluscan shellfish), will be frozen before service or sale in ready-to-eat form as follows:

(1) Frozen throughout to a temperature of:

(a) -4°F (20°C) or below for 168 hours (7 days) in a freezer.

(b) -31°F (-35°C) or below for 15 hours in a blast freezer.

d. Safe Egg Handling Guidelines:

(1) Serving raw eggs and foods containing raw eggs is prohibited.

(2) Recipes which call for uncooked eggs, e.g., mayonnaise, eggnog, ice cream, Caesar salad dressing, hollandaise sauce, etc., will be prepared using only pasteurized frozen table eggs.

(3) Shell eggs that are broken and prepared to order and for immediate service, will be cooked to a minimum internal product temperature of at least 145°F for at least 15 seconds or until the white is firm, not running, and the yolk is set.

(4) Scrambled eggs, in bulk amounts, may be prepared using pasteurized frozen table eggs, pasteurized dehydrated egg mix, or fresh shell eggs. If fresh shell eggs are used, the following provisions are required:

(a) Cook bulk amounts of scrambled eggs in small batches of no more than 3 quarts. Cook to heat all parts of the food to a minimal internal temperature of 155°F (63°C) for at least 15 seconds and until there is no visible liquid egg.

(b) Hold until served at 140°F or higher, such as on a hot food table.

(c) Do not combine just cooked scrambled eggs to the batch held on a hot food table. A clean sanitized container is required for each 3 quarts of scrambled eggs.

3-5.3 Safe Holding Temperatures for Cooked Food

a. General. Potentially hazardous foods which are not served immediately after cooking must be either rapidly chilled to temperatures of 41°F or lower, or held at 140°F or higher. Growth of harmful bacteria and the development of toxins (poisons) formed by bacteria occur rapidly in protein foods when held at temperatures between 41°F and 140°F. Potentially hazardous foods which have been held at temperatures between 41°F and 140°F longer than 4 hours are considered unsafe for consumption and must be destroyed. If the product is refrigerated at intervals and then permitted to warm, the total time of the various periods between 41°F and 140°F must not exceed 4 hours.

b. Potentially hazardous ingredients for foods that are in a form to be consumed without further cooking such as salads, sandwiches, filled pastry products and reconstituted foods must have been chilled to 41°F or below prior to preparation.

3-5.4 Reconstituting or Fortifying Food

a. The ingredients and the container must be prechilled to 41°F or below before reconstituting or fortifying a potentially hazardous food with the addition of a dry ingredient such as dry milk or milk product, a dessert mix or similar product if the container is larger than 1 gallon.

b. A potentially hazardous food which has been reconstituted or fortified by the addition of a dry ingredient such as dried milk, eggs, soup, sauce, dessert mix or similar product, if not for immediate service, must be:

(1) Held at 41°F or below until served;

(2) Immediately placed, after mixing, into either a frozen dessert machine or other liquid product refrigeration unit; or

(3) Held at 140°F or above.

c. A reconstituted or fortified potentially hazardous food that is held between 41°F and 140°F for longer than 4 hours will be discarded.

3-5.5 Time as a Public Health Control

Time only, rather than time in conjunction with temperature, may be used as the public health control for a working supply of potentially hazardous food before cooking, or for ready to eat potentially hazardous food that is displayed or held for service for immediate consumption, if:

a. The food is marked or otherwise identified with the time within which it shall be cooked, served, or discarded;

b. The food is served or discarded within 4 hours from the point in time when the food is removed from temperature control;

c. Food in unmarked containers or packages, or for which the time expires, is discarded;

d. Temperature logs are required to document cooling and ensure all requirements are met.

3-5.6 Advance Preparation/Leftovers

3-5.6.1 Advance Preparation

a. "Advance Preparation" is defined as food that is prepared for future service beyond a specific meal. Advanced preparation foods that include PHF may not be retained as leftovers. Advance preparation foods must not be placed in "Hot Holding," and must be immediately cooled after cooking, as indicated below.

(1) Hot items to be retained chilled, must be cooled within a 4-hour period in the following manner:

(a) From required cooking temperature (as noted in this chapter) to 70°F within 2 hours; and

(b) From 70°F to 41°F, or below, within the total 4 hour period.

(2) "Advance Preparation" foods that are prepared from ingredients at ambient temperature, such as reconstituted foods or canned food ingredients, must be cooled to 41°F or below within 4 hours.

(3) Temperature logs are required to document cooling and ensure all requirements are met.

b. Rapid cooling of "Advance Preparation" foods will be accomplished by using one or more of the following methods to bring the product temperature from the required cooking temperature to 41°F or below within the 4-hour period:

(1) Quick chilling with ice bath and agitation (stirring mechanically or manually every 20 to 30 minutes).

(2) Portioning to shallow pans (3 inches (7.6 cm) product depth or less) or smaller containers (1 gallon or less).

(3) Using prechilled pans and containers for portioning products.

(4) Circulating cold water in steam jacket or kettles (where feasible).

(5) Short term storage with agitation in walk-in refrigerator operating below 38°F, or in a rapid chill refrigerator to reduce the temperature prior to placing in a standard refrigerator.

(6) Immersing the cooking container in cold, running water with product agitation.

(7) Spreading sliced or layered solid items in shallow pans, then refrigerating.

(8) Distributing the product among several refrigerators.

(9) Using metal, stainless steel or aluminum, containers. (Metal containers have higher rates of heat transfer than plastic or glass containers.)

(10) Using reduced water content for recipes such as stews. After cooking add potable ice to make up the volume of water and promote rapid cooling.

(11) Using ice type paddles.

c. Protect advance preparation foods from contamination by the following:

(1) Hot foods may be loosely covered, or uncovered if protected from overhead contamination during the cooling period to facilitate heat transfer from the surface of the food.

(2) Tightly cover food as soon as possible after the product temperature reaches 41°F.

(3) Potentially hazardous foods to be transported will be prechilled and held during transport at an internal product temperature of 41°F or below unless maintained per section 3-4.3(B).

d. "Advance Preparation" food items that are considered potentially hazardous food may be retained for use or sale up to 72 hours from the original time of preparation.

(1) The HACCP princiles found in section 3-8 of this chapter should be followed, but a formal HACCP plan is not normally required.

(2) A waiver may be requested, based on a written HACCP plan, from the PMA to extend "Advance Preparation" holding time from 72 hours up to 7 days. Guidance for a HACCP plan is located in section 3-8 of this chapter.

e. Labeling of "Advance Preparation" food is required.

(1) "Advance Preparation" food must be labeled "Advance Preparation Food" with the date and time of original preparation and the required discard date and time. Other methods for labeling may be used if approved in writing by the PMA.

f. Reheating "Advance Preparation" food items that are considered potentially hazardous food.

(1) Potentially hazardous food that has been cooked and then refrigerated and which is reheated for hot holding must be reheated so all parts of the food reach 165°F for a minimum of 15 seconds. It must then be held at 140°F or above until served. The time for reheating to 165°F will not exceed 2 hours.

(2) However, food taken from commercially processed hermetically sealed containers, food in intact packages from commercial food processing establishments, and whole or remaining unsliced portions of beef roasts may be reheated to 140°F for hot holding.

(3) Potentially hazardous foods which are not reheated to 165°F before serving, (e.g., custards and cream filled pies) that have been cooled to 41°F or below after preparation and have been maintained at 41°F or below must be served within 72 hours of cooking. These food items must be used within two hours after removal from refrigeration.

g. Commercial meats, cheeses and salad requirements are found under section 3-5.17.

h. A waiver for freezing of limited menu items that are advance prepared foods, (e.g., lumpia, egg rolls) may be authorized by the PMA under certain conditions, but may require an HACCP plan.

3-5.6.2 Leftovers

a. Leftovers are any unserved food remaining at the end of the meal period for which it is prepared. Served food, or food that has been placed on a serving line does not qualify and must be discarded. Leftovers are categorized as potentially hazardous food and nonpotentially hazardous food.

b. Nonpotentially hazardous leftovers are such items as individual commercially packaged crackers, condiments, etc., which may be recovered from the serving line, but not dining tables or trays, and be retained for reuse. Bottled condiments that do not require refrigeration (e.g. mustard, catsup/ketchup, steak sauce, etc.) may be retained for reuse. Unsliced, hard skinned fruits may be retained from serving lines for reuse provided they are washed.

c. Potentially Hazardous Leftovers. Potentially hazardous leftovers include any potentially hazardous food prepared for a specific meal period and then retained for a later meal period. This section does not apply to advance prepared food as defined in section 3-5.6.1 The following provisions apply:

(1) Foods with commercially prepared chopped or ground meat ingredients may be retained as leftovers.

(2) Potentially hazardous food retained as leftovers must have been held at safe temperatures.

(3) Potentially hazardous food must not have been placed on the serving line. They must have been held in the kitchen for "hot holding" at 140°F or in "cold holding" at 41°F or below.

(4) Hot items to be retained chilled, must be cooled within a 4-hour period, in the following manner:

(a) From 140°F to 70°F within 2 hours; and

(b) From 70°F to 41°F, or below, within the total 4-hour period.

1 Any food not meeting these temperature requirements at the specified times will be discarded.

2 These food items must be maintained at 41°F or below until removed for service or heating for hot holding prior to service.

3 Rapid cooling methods are discussed in section 3-5.6.1.

(c) Potentially hazardous leftovers must be labeled "Leftover Use Within 24 Hours" with the date and time of original preparation and the discard date and time. Other methods for labeling may be used if approved in writing by the PMA.

d. Potentially hazardous foods which have been cooked, chilled and reheated for service shall not be saved as leftovers.

e. Leftover foods may be retained for 24 hours chilled (41° F or below) or for 5 hours if maintained hot (140° F or above). The time limit(s) for leftovers begins when the food is removed from hot holding. No temperature logs are required but foods must not be in the "danger zone" between 41° F and 140° F for more than four total hours from time of preparation until discarded.

f. Freezing of leftovers is prohibited.

g. Reheating Leftover Potentially Hazardous Food. Potentially hazardous food that has been cooked and then refrigerated and which is reheated for hot holding must be reheated so that all parts of the food reach 165°F for a minimum of 15 seconds and then held at 140°F or above until served. The time for reheating to 165°F will not exceed 2 hours.

h. Commercial meats, cheeses and salad requirements are found under Section 3-5.16.

i. Prohibited Leftovers

(1) Foods composed of ingredients which have been peeled, sliced, or diced by hand after cooking must never be used as leftovers, since the 4-hour time limit between temperatures of 41°F and 140°F is usually taken up in preparing, chilling, and serving the food.

(2) These foods include, but are not necessarily limited to potato salad, chicken salad, turkey salad, macaroni salad, shrimp salad, egg salad, and similar items. Also included are foods that have been creamed or handled a great amount (e.g., hashes, most gravies and dressings, and creamed meats) and items that are highly perishable (e.g., most seafood).

(3) Nonpackaged or unwrapped potentially hazardous food recovered from a self-service line must not be retained as leftovers.

3-5.6.3 Donation of Excess Food to Local Relief Organizations

Guidance for donation of excess food to local relief organizations and similar programs may be obtained from the Naval Supply Systems Command. It is recommended that commands donating excess food follow a HACCP system.

3-5.7 Frozen Foods

a. The storage of frozen foods shall be limited to the storage life listed in NAVSUP PUB 486, Volume 1, Chapter 5.

b. Thawing Procedures.

(1) Frozen foods must not be thawed by exposure to excessive heat or warm air currents. The ideal procedure is to place frozen foods under controlled thawing temperatures (36°F to 38°F) in their original wrappers or containers.

(2) Frozen foods may be thawed in microwave ovens provided they are immediately cooked thereafter as a part of a continuous cooking process.

(3) At shore based facilities frozen foods may be thawed completely submerged under running water:

(a) At a water temperature of (21°C) 70°F or below;

(b) With sufficient water velocity to agitate and float off loose particles in an overflow;

(c) For a period of time that does not allow thawed portions of ready-to-eat food to rise above 41°F (5°C);

(d) For a period of time that does not allow thawed portions of a raw animal food requiring cooking to be above (41°F) 5°C for more than 4 hours including:

<u>1</u> The time the food is exposed to the running water and the time needed for preparation for cooking, or

<u>2</u> The time it takes under refrigeration to lower the food temperature to 5°C (41°F).

(4) On board ships, and only during emergency situations when microwave ovens and refrigeration equipment are inoperative, it may be necessary to use a thawing method not approved by FDA (e.g., thawing at room temperature). In this situation, the following guidelines must be used:

(a) Frozen foods are thawed in the galley or meat preparation space;

(b) The room temperature must not exceed 80°F.

(c) Meat, poultry, and fish must remain in their original sealed wrappers or containers;

(d) Proper precautions must be taken to ensure potentially hazardous foods are not allowed to remain at room temperature once thawed;

(e) The preventive medicine authority must be notified.

c. Commercial type Frozen Food Operation. This is the only authorized operation in which food intended for use at a future time is prepared, frozen, and stored. Navy and Marine Corps frozen food processing operations must obtain CHBUMED approval for operations not previously authorized.

d. Freezing of leftovers is not authorized.

e. A waiver for freezing of limited menu items that are advance prepared foods, (e.g., lumpia, egg rolls) may be authorized by the PMA under certain conditions and may require an HACCP plan.

3-5.8 Reconstituted, Dehydrated Foods

Food items such as dehydrated eggs and vegetables are as susceptible to spoilage after reconstitution as the fresh items. Dehydrated foods must be reconstituted with chilled ingredients and be cooked or refrigerated immediately following reconstitution.

3-5.9 Sandwiches

Sandwich preparation shall meet all of the requirements of this chapter. Sandwiches prepared for future service will require approval from the PMA and may require a HACCP plan.

3-5.10 Serving Lines

a. All serving lines must be equipped with a functional sneeze shield. To be functional, a sneeze shield must present a barrier between the oral zone of patrons within the normal range of stature and the food displayed for service.

b. The temperatures of hot and cold foods on the serving line must be checked frequently to ensure no food is held between 41-140°F.

3-5.11 Salad Bars

a. Salad bars may be set up on a self-service basis and must be equipped with a sneeze shield. To assure all salad bar items remain below 41°F, they must be prechilled in a refrigerator and placed in pans or trays which are located on a bed of ice or on an electrically refrigerated salad bar unit. Proper drainage is essential when ice is used.

b. Potentially hazardous foods must be placed on the salad bar in small quantities and be replenished in clean containers as needed. Sprouts are considered a PHF.

c. Vegetable items on the salad bar may be kept until the end of the day as long as a visual inspection is made during each meal period to ensure food quality. Noncommercially prepared salad dressings placed on the salad bar in an open container must be discarded at the end of the meal period. Other potentially hazardous food placed on the salad bar must be discarded at the end of the meal period.

d. Commercially prepared salad dressings which are packaged in and served from small bottles (usually 8 ounces) are exempt from the requirement to discard any leftover portions provided they are kept under refrigeration during storage.

e. An adequate number of proper serving utensils for the salad bar must be provided. Food dispensing utensils must be stored either in the food with handles extended or in running water.

f. Certain commercial brands of mayonnaise and salad dressings are exempted from the requirement for refrigeration during meal periods. They must employ the use of an NSF or equivalent approved dispensing pump and be refrigerated between meal periods. After 48 hours any unused products must be discarded as garbage. The dispensing pump must be cleaned and sanitized immediately prior to installing on the container; too frequent removal of the pump while the container is in service may result in possible contamination of the product. External cleaning of the pump with a sanitizing solution, when in place, can be accomplished if necessary. Similarly, individual single service packages of mayonnaise, other condiments, and salad dressings do not require refrigeration.

g. Patrons must be required to use new tableware for each trip to the salad bar.

3-5.12 Self-service Items

a. Food items permitted in self-service areas in addition to salads are bread, butter, crackers, relishes, condiments, beverages, and certain types of desserts. Desserts which may be self-served are:

(1) Desserts portioned in individual dishes;

(2) Individually wrapped portions of ice cream. Bulk ice cream will not be used for self-service. Ice cream must be placed in individual dishes.

(3) Cookies;

(4) Fruits (fresh, canned, stewed, and frozen);

(5) Soft ice cream from dispensing machines.

b. Desserts such as cakes, pies, puddings, and bulk ice cream will not be self-service unless provided in individual dishes.

c. Food dispensing utensils must be stored in the food with handles extended or in running water. Dry food dispensing utensils must be stored clean and dry or in the dry food. These utensils must be designed for this purpose. Self-service lines shall be carefully supervised throughout the meal period to keep foods neatly arranged and replenished.

d. Authority to permit self-service of items other than those listed in the preceding paragraphs must be requested in writing from the installation preventive medicine authority.

3-5.13 Buffets

a. Buffet type meals have the potential of providing ideal temperatures for rapid growth and multiplication of pathogens. Therefore, it is essential that potentially hazardous foods not be held for more than 4 hours between 41-140°F including the time required for preparation and holding time before, during and after serving.

b. All food remaining on the buffet line must be discarded at the end of the meal period.

c. Patrons must be required to use new tableware for each trip to the buffet line.

3-5.14 Family Style Service

a. Certain small messes are authorized "family style" service when serving facilities are not available. However, due to the lack of food holding equipment and the potential for contamination during service, strict compliance with the 4-hour rule is mandatory.

b. Foods must be placed out for service as close to meal periods as possible in small quantities and be replenished as needed during the meal.

c. Adequate and proper serving utensils must be provided for each food item.

d. Salad mixtures, salad dressings and other potentially hazardous foods to be served cold must be prechilled to 41°F or lower, prior to service and then be placed in pans on a bed of ice during service.

e. Potentially hazardous foods served "family style" must be discarded as garbage after the meal period.

f. Bulk ice cream must not be served "family style."

g. Serving bowls/platters will not be refilled; clean bowls/platters must be used. Any food not consumed must be discarded.

3-5.15 Special Meals

The 4 hour maximum time permitted for holding potentially hazardous foods at temperatures between 41-140°F is of particular importance in the case of special meals (boat meals, flight meals, and recreation parties). All types of flight rations must be carefully packaged to preclude the risk of contamination and exposure during transit.

3-5.16 Commercial Meats, Cheeses, and Salads

The following sanitary guidelines have been developed exclusively for the handling and storage of commercially processed bulk food items:

a. Preslicing must be restricted to high turnover items.

b. When used, bayonet type pricing mounts will not be allowed, under any circumstances, to penetrate the food product. Instead, they should be mounted into lemons or similar fruits for display purposes.

c. Use all salads, including the contents of a master container, within 72 hours after opening. On each master container, mark the date and time it is opened. Use only commercially prepared products purchased from suppliers listed in the Directory of Sanitarily Approved Food Establishments for Armed Forces Procurement or other Government inspection directories. Handle salads as follows:

(1) Sanitarily remove only the amount of salad expected to be used/sold in 1 day from the master container and place in a clean, sanitized pan in the display case. Label the pan with the date the master container was opened, the lot number, the name of the supplier (if more than one source of supply is used), and the expiration date.

(2) At the close of business each day, dispose of small amounts (1 quart or less) of leftover salad. Cover pans containing larger amounts (more than 1 quart) with clean wrap and leave in the display case or place into backup refrigeration. Do not use aluminum foil, it will chemically react with some foods. At the beginning of the next workday, place the leftover salad into a clean sanitized pan. Position the pan so the leftover salad will be used/sold first. Never put salads from the display case back into the master container.

d. Handle meats and cheeses as follows:

(1) Commercially prepared high moisture cheeses, luncheon meat loaves, roast beef, ham, and similar products prepared and packaged by a food processing plant shall be clearly marked, at the time the original container is opened in a food establishment. Marking must indicate the date by which the food shall be consumed, including the date the original container was opened:

(a) All meats and cheese must be consumed within 7 calendar days after opening. All meats and cheeses must be maintained at or below 41°F.

(b) These items should be visually inspected upon each use and discarded at the first sign of product deterioration.

e. Individually sliced and wrapped commercially prepared cheeses shall be used or disposed of prior to their pull date.

If visual inspection reveals problems prior to the pull date, the affected slices will be disposed of as waste.

3-6 SPECIAL FACILITIES AND VENDING OPERATIONS

3-6.1 Clubs, Messes, Exchanges and Concessions (Food Service) and Delicatessens

All clubs, messes, exchanges, and concessionary food service operations must comply with sanitary standards and regulations prescribed in this chapter. The person in charge (military or civilian) should maintain close liaison with the preventive medicine authority to ensure compliance with all sanitation requirements. These food establishments must be inspected at the same intervals as any food establishment by the PMA.

3-6.2 Auxiliary Resale Outlets (ARO)

OPNAVINST 4060.4 contains procedures to establish and operate AROs. The PMA will inspect these outlets upon establishment and on an unscheduled basis after commencement of operations. A determination will be made whether PHF is being sold. AROs selling PHF will be considered food establishments and all provisions of this manual shall apply.

3-6.3 Vending Operations

a. Vending machines placed into operation on Navy and Marine Corps installations must comply with the standards of "The Vending of Food and Beverages-A Model Sanitation Ordinance, Food and Drug Administration" and be found on the "Listing of Letters of Compliance" by the National Automatic Merchandising Association.

b. Inspections. The PMA shall ensure by inspection on a quarterly basis, that vending machines are maintained in a sanitary manner.

3-6.4 Mobile Food Service

a. Mobile food service or canteen trucks are operated as authorized by the Navy Exchange Manual and MCO 4066.13. They must be maintained in a clean, sanitary condition at all times. Only single service articles will be provided for use by the consumer. Food service sanitation training is a requirement for operators who dispense food items from these vehicles. The PMA must regularly inspect these Government operated trucks and carts while they are in operation.

b. Nongovernment operated food vendors must be licensed and approved by the local or State health authority and must be registered with the local PMA. The inspection frequency will be determined by the PMA, but must be done at least quarterly.

c. All food service equipment in mobile vans must be equivalent to or meet applicable design and performance standards of NSF Standard No. 59 or its equivalent.

d. Transportation of food from a centralized kitchen to a satellite dining facility poses special hazards which increase in proportion to distance and time. Therefore, all foods must be transported in covered containers or completely wrapped or packaged to protect them from contamination, and all potentially hazardous food must be maintained at 41°F or below, or 140°F or above during transportation.

3-6.5 Commissaries

Commissaries will normally be inspected by U.S. Army veterinary personnel. When U.S. Army personnel are not available, commissaries will be inspected by Navy PMA using the current methods established by the U.S. Army VETCOM Instructions.

3-6.6 Coffee Messes

a. The term "coffee mess" means any room, space, area, or facility authorized by a department or office for the purpose of preparing or dispensing coffee, tea, or similar beverages. Food is not authorized to be stored, prepared or served in coffee messes.

b. Coffee messes require no initial or periodic medical inspections by the PMA.

3-6.7 Child Development Centers and Family Home Care Units

a. Child development centers are command sponsored child care facilities located on station and operated as authorized by OPNAVINST 1700.9 series. Food service operations in these centers will comply with this chapter.

b. Family Home Care Units are provided in Government quarters (Government owned or leased) and approved by the local commanding officers and housing authority. Care may be provided for up to six children by a private individual in a Navy family housing unit.

(1) These units are not subject to routine food service sanitation inspections. However, OPNAVINST 1700.9 series requires the Preventive Medicine Service to conduct an initial and annual inspection of family home care units.

(2) Commercial food service sanitation requirements (e.g., NSF equivalent refrigeration units, dishwashers, three compartment sinks, etc.) will not be applied to family home care units.

3-7 TEMPORARY FOOD SERVICE

3-7.1 Requirements

Temporary food establishments will comply with all of the requirements of this chapter unless an exemption is granted by the PMA or is listed in this section. Specific requirements and exceptions for temporary food establishments are provided in this section.

3-7.2 Inspections and Approvals

a. The preventive medicine authority will inspect and approve temporary food establishments prior to start of operations. The individual or agency responsible for the temporary food establishment shall contact the PMA at least 30 days prior to opening to obtain a permit to operate the facility. A model form for requesting a permit to operate a temporary food establishment is available in this chapter in Appendix C.

b. The PMA may:

(1) Waive certain requirements when no health or sanitation hazard exists. An example is waiving the requirements for screens and doors during cold weather when no hazard exists from flies contaminating food.

(2) Impose additional requirements to protect public health. Examples would be; restricting the amount or type food preparation, or prohibiting certain high risk potentially hazardous food.

3-7.3 Types of Operations

Temporary food service operations are divided into two general classes:

a. Restricted Operations. Restricted operations are temporary food establishments where only potentially hazardous food (PHF) requiring limited preparation, such as hamburgers and frankfurters, are prepared or served. Foods held at unsafe temperatures will be discarded and leftovers are prohibited. The preparation or service of other PHF is prohibited, except restricted operation facilities can serve PHF that are:

(1) Prepared and packaged in a food establishment and under conditions meeting the requirements of this chapter (e.g., central kitchen or commissary);

(2) Obtained in individual portioned containers or packages from approved sources;

(3) Stored at an internal product temperature of 41°F or below, or 140°F or above in equipment meeting the requirements of this chapter.

(4) Served directly in the unopened, individual serving container or package in which it was obtained.

b. General Operations. Nonrestricted operations will comply with all of the requirements of this chapter. Any waivers to this chapter must be requested in writing from the preventive medicine authority.

3-7.4 Equipment

a. Locate and install equipment to prevent food contamination and facilitate cleaning.

b. Protect against contamination of food contact surfaces of equipment by consumers, food service personnel and other contaminating agents. Provide effective shields and sneeze guards for equipment.

3-7.5 Single service Articles

Temporary food establishments without adequate facilities for cleaning and sanitizing tableware will only use individually wrapped, single service articles.

3-7.6 Water

a. Provide adequate potable water for food preparation, cleaning and sanitizing utensils and equipment, and for hand washing. Provide a potable water heating system capable of producing adequate hot water for cleaning and sanitizing on the premises. If adequate hot water is not available, the scope of food service operations will be limited to the preparation and service of foods that do not require cleaning and sanitizing of equipment and utensils. The PMA may authorize alternative procedures for cleaning and sanitizing equipment and utensils.

b. Temporary food establishments without permanent water supplies must have potable water for cleaning and hand washing.

c. Potable water must be from commercial potable water trailers, temporary connection to building water supply, or in clean sanitary containers or hoses.

(1) Hoses used to carry water for food preparation, drinking water, ware washing and hand washing must be made of food grade material approved for potable water. ("Use of garden hoses is prohibited except for general area cleanup, e.g. for washing down floors and picnic tables). Temporary connections to potable water supply shall not violate plumbing codes. The hose bib shall be connected with a vacuum breaker or other backflow prevention device.

3-7.7 Sewage

All sewage will be disposed of in a sanitary sewer.

3-7.8 Hand Washing

Provide a convenient hand washing facility for employee hand washing. The facility will have at least running water, soap, and individual paper towels. The PMA may approve field expedient hand washing facilities. Food service personnel shall follow hand washing guidance provided in this chapter.

3-7.9 Floors

When provided, floors will be constructed of concrete, asphalt, tight wood, or other similar cleanable material, be graded to drain and kept in good repair. The preventive medicine authority may approve using dirt or gravel as subflooring provided floors are:

a. Graded to drain;

b. Covered with clean, removable platforms or duckboards, or other suitable nonabsorbent materials effectively treated to control dust.

3-7.10 Walls and Ceilings of Food Preparation Areas

When required by the PMA, walls and ceilings of temporary food preparation areas shall meet the following standards:

a. Construct walls and ceilings of wood, canvas, or other material that protects the interior of the establishment from the weather and dust.

b. Construct walls and ceilings of food preparation areas in a way that minimizes the entrance of insects.

c. Use at least 16 mesh to the inch screening material for walls, doors, or windows.

d. Make counter service openings as small as possible for the particular operation conducted. Provide these openings with tight-fitted solid or screened doors or windows, or other construction to restrict the entrance of flying insects.

e. Surface outdoor walking and driving areas with concrete, asphalt, gravel or other material authorized by the preventive medicine authority to effectively minimize dust, facilitate maintenance and prevent muddy conditions and pooling of water.

f. Provide adequate number of covered trash containers. Line trash cans with plastic bag(s).

g. Minimize exposed utility lines, water and waste lines and pipes. Install lines to minimize obstruction for cleaning and minimize safety hazards.

3-8 HACCP INFORMATION

3-8.1 General Information

a. The abbreviation HACCP stands for Hazard Analysis and Critical Control Points. This is a food safety system developed to prevent the occurrence of potential food safety and sanitation problems. An HACCP Plan is the written document, based on the principles of HACCP, which delineates the procedures to be followed at a food establishment to assure the control of a specific process or procedure. Essentially HACCP is a system that identifies, monitors and controls specific food sanitation related, biological, chemical or physical hazards, that can adversely effect food safety and lead to the occurrence of a food borne illness. A HACCP Plan may be required by the PMA for certain operations/facilities.

b. The HACCP system focuses on controlling critical offenses that have been associated with numerous outbreaks of food borne illness. Below are some examples of critical offenses, the list is not inclusive. Five of the eight critical offenses are time and/or temperature. The remaining three involve cross contamination.

(1) Improper cooling of food.

(2) Inadequate cooking times and temperatures.

(3) Contamination of food by infected food service workers, including poor personal hygiene.

(4) Food prepared a day or more prior to serving.

(5) Contamination of food, not receiving further cooking, by addition of raw (contaminated) ingredients. Examples; spices and similar raw ingredients.

(6) Foods remaining at unsafe temperatures.

(7) Failure to reheat foods to proper temperature.

(8) Cross contamination of cooked food with raw foods or by employees who mishandle food or improperly cleaned equipment.

3-8.2 Steps of a HACCP Plan

A HACCP Plan is divided into seven (7) principles, or steps.

a. Principle #1. Identify Potentially Hazardous Foods.

(1) Hazard and Risk Definitions:

(a) Hazard: Any biological, chemical, or physical property that may cause an unacceptable consumer health risk.

(b) Risk: A likelihood of a hazard.

(2) The first step is to identify the hazards associated with the operations.

(3) Begin with the menu. Select the "most hazardous" menu items or ingredients. Particular attention should focus on foods or ingredients that are common to many different menu items. For example:

(a) Ground beef may be an ingredient in many different menu items including spaghetti sauce, creamed beef, chili, meat loaf and hamburgers.

(b) Don't focus initial efforts on menu items or ingredients that are only served one or two times per month.

(4) Then look at menu items with the greatest potential for contamination or those which are most hazardous.

(a) Meat sauce, gravy, quiche and high protein salads require extensive preparation steps. Contamination can occur at any step, or the raw products can be contaminated.

(b) Items such as fresh fish or shell fish can be contaminated and spoil rapidly.

(5) Work one menu item or ingredient at a time. Set up a flow chart from receiving, through storage, preparation, cooking, serving and disposal of the item. Include rapid cooling and storage of advance preparation foods and leftovers if appropriate. On this flow chart identify where the item could be contaminated as well as the relative risk, severity and probability, of each hazard.

b. Principle #2. Identify the Critical Control Points (CCPs) in Food Preparation.

(1) A CCP is defined as a point, step, procedure in which a food safety hazard can be prevented, eliminated, or reduced. Examples of critical control points CCPs may include but are not limited to: cooking, chilling, specific sanitation procedures, prevention of cross-contamination, and certain aspects of employee and environmental hygiene.

(2) The following questions may be used in identifying CCPs:

(a) Can the hazard be prevented, eliminated or controlled through measures or procedures that can be implemented by the food service operation?

1 Contamination of animal feed with pesticides, or contamination of poultry with *salmonella* are hazards, but they are not CCPs because the food establishment cannot control them. Purchasing USDA inspected meat and poultry are important but not normally a CCP.

2 Cooking beef or poultry to correct time and temperature are CCPs. The food service facility can control hazard associated with inadequate cooking.

(b) Does this step eliminate or reduce a hazard?

(c) Could contamination occur, or could contamination increase to unacceptable levels?

c. Principle #3: Establish Critical Limits (CLs) for the CCPs.

(1) Critical limits are defined as the criteria that must be met for each preventive measure associated with a CCP. Critical limits may be set for preventive measures such as temperature, time, physical dimensions, humidity, moisture level, water activity, pH, acidity, salt concentration, available chlorine, preservatives, or sensory information such as texture, aroma, and visual appearance.

(a) Incorporate control procedures into the written recipes, for example:

1 Process Step: Hamburger Patty Cooking - Minimum internal temperature of patty: 155°F; Time: Minimum 15 Sec.; oven temperature:___°F; patty thickness:___ in inches; patty composition: 100% beef.

(b) Enforce employee hand washing and hygiene practices.

(c) Establish illness policy for employees with flu like symptoms of diarrhea and vomiting.

(d) Enforce proper cleaning and use of sanitizer solutions.

(2) Critical limits must be measurable or observable. The more specific a CL is, the easier it is to monitor. Avoid terms like thoroughly heated, cool rapidly, serve hot. If there is a measurable limit, specify it.

d. Principle #4: Establish Procedures to Monitor CCPs.

(1) Monitoring does not have to be elaborate. It can include checking the temperature of food on a serving line, or taking the temperature of foods being cooled.

(2) Monitoring is a planned sequence of observations or measurements to assess whether a CCP is under control and to produce an accurate record for future use in verification. Examples of measurements for monitoring include:

(a) Visual observations

(b) Temperature

(c) Time

(d) pH

(e) Moisture level

(3) Assignment of the responsibility for monitoring is an important consideration for each CCP. The person responsible for monitoring must also report a process or product that does not meet critical limits so immediate corrective action can be taken. For example:

(a) Assign one person to make and test sanitizer solution each day.

(b) Assign responsibility for equipment temperature logs.

(c) Assign responsibility for food temperature logs for cooking, cooling, and reheating.

(4) All records and documents with CCP monitoring are to be signed or initialed by the person doing the monitoring.

e. Principle #5: Establish the Corrective Action(s) To Be Taken When Monitoring Shows a Critical Limit (CL) Has Been Exceeded.

(1) The HACCP system for food safety management is designed to identify potential health hazards and to establish strategies to prevent their occurrence. However, ideal circumstances do not always prevail. Therefore, when deviation occurs, corrective action plans must be in place to:

(a) Determine whether food should be discarded.

(b) Correct or eliminate the cause of problem.

(c) Maintain records of corrective action taken.

(2) Actions must demonstrate the CCP has been brought under control. Individuals who have a thorough understanding of HACCP process, product, and plan are to be assigned responsibility for taking corrective action. Corrective action procedures must be documented in the HACCP plan.

(a) Corrective Actions may include:

<u>1</u> Raising or lowering the thermostat on a piece of equipment.

<u>2</u> Reclassifying a food as leftover, reheating to 165°F within 2 hours and serving that item the next meal.

<u>3</u> Dividing a food item being chilled into several smaller containers.

(b) Corrective actions should be developed and in place before the CL is exceeded. The staff must know what protective actions should be followed and under what circumstances.

f. Principle #6. Establish Effective Record Keeping Systems.

(1) Record keeping for HACCP need not be a chore or excessive burden.

(a) If a critical limit (CL) for fresh fish is delivery on shaved ice at 34 to 41° F internal product temperature, the food service employee who receives the delivery should check the product temperature and record it on the delivery invoice.

(b) If a CL requires rapid cooling, within 4 hours from an internal temperature of 140° F to 41°F, then the food service employee should take the product temperature and record the temperatures at the time from when the product reached 140° F until it reached 41°F.

(2) Keeping good records is especially important for production operations such as sandwich shops, central kitchens or vending commissaries and cook chill production kitchens.

(3) The associated records should be on file at the food establishment. Generally, such records include the following:

(a) Listing of the HACCP team members and assigned responsibilities.

(b) Description of the food and its intended use, product description, and specifications.

(c) Listing of all regulations that must be met.

(d) Ensure adequate environment, facilities, and equipment.

(e) Monitor equipment with temperature logs.

(f) Copies of flow charts from receiving to consumption.

(g) Hazard assessment at each step in flow diagram (include calibration of equipment).

(h) The critical limits established for each hazard.

(i) Monitoring requirements for temperature, sanitation, finished product specifications, and distribution.

(j) Corrective action plans when there is a deviation in policy, procedure, or standard CCP.

(k) Procedures for verification of HACCP system.

g. Principle #7. Establish Procedures to Verify the HACCP System is Working.

(1) Verification procedures include both the person in charge and the PMA.

(2) The person in charge should, among other actions,

spot check temperatures of products in the refrigerators; check invoices for temperatures of food on delivery and check temperatures of food on serving line and being removed from cooking. The person in charge should also watch to see if employees are washing their hands, cleaning and sanitizing equipment, and taking other steps to limit cross contamination.

(3) Verification procedures may include:

(a) Establishment of appropriate verification inspection schedules.

(b) Review of the HACCP plan.

(c) Review of the CCP records.

(d) Review of the deviations and dispositions.

(e) Visual inspection of operations to observe whether CCPs are under control.

(f) Random sample collection and analysis.

(g) Review of critical limits to verify they are adequate to control hazards.

(h) Review of written record of verification inspections covering compliance, deviations, or corrective actions taken.

(i) Review of modifications of the HACCP plan.

3-8.3 HACCP Inspection Guidelines

a. The PMA, when looking at a food service establishment with an implemented HACCP program, should:

(1) Try to determine if the food service personnel understand and are following the HACCP system for the facility.

(2) Concentrate on the critical offenses associated with incidence of food borne illness, including time temperature control and prevention of cross contamination.

(3) Begin a HACCP based sanitation inspection with the menu.

(a) Using the menu, the cook worksheet or production schedule, try to determine the flow of food through the facility. If the facility has flowcharts for major menu items, examine these for clarity, completeness, CCPs, and CL.

(4) Try to inspect the facility based on the flowchart or other available SOPs, etc.

(a) Start with the refrigerated storage. Take the internal product temperature of a representative sampling of the food. Are the product temperatures and item consistent with the menu and the cook worksheet/production schedule?

(b) Check invoices and receiving records. Are potentially hazardous foods checked at delivery for wholesomeness, product temperatures, etc.? If a delivery is taking place, do food service workers wash their hands before and after handling raw PHFs? Are they using a sanitized product thermometer?

(c) Observe food preparation for personal hygiene, hand washing, wearing clean disposable gloves, using clean sanitized utensils, and other practices which limit cross contamination.

(d) Observe cooking processes. Do cooks check the internal product temperatures? Are PHFs removed from the oven and placed either in hot food holding or cooling promptly; or, are foods left on stoves, counter tops, etc. for long periods? Are leftovers rapidly heated to 165° F before being placed on the serving line?

(e) Check serving line. Are foods at correct product temperatures. Are foods such as soups, salads and other items brought out at correct temperatures and in small batches?

(f) Check cooling techniques for leftovers and pre-prepared foods. Are the techniques appropriate? Do they work?

(g) Talk to the food service personnel. Do employees understand the HACCP system, CCPs and critical limits that effect their work? Knowledge of what to do if critical limits are exceeded or not met?

(h) Examine training records. Are managers trained? Do employees receive adequate ongoing training appropriate to their position?

b. Remember the goal of the HACCP system is to prevent food borne illness by identifying and controlling hazards.

Section IV. STANDARDS AND SANITATION OF FOOD SERVICE EQUIPMENT AND UTENSILS

4-1 STANDARDS

a. All equipment and utensils used in food establishments under Navy and Marine Corps jurisdiction must be constructed of sanitary, nontoxic, corrosion resistant materials designed, assembled, and installed to provide for ease of cleaning. Sanitary standards for the equipment shall not be less than those promulgated by an American National Standards Institute (ANSI) accredited third party organization (e.g., the National Sanitation Foundation (NSF) or equivalent). Shipboard food service equipment must comply with NAVSUP PUB 533, Shipboard Food Service Equipment Catalog.

b. Stationary equipment must be installed to permit proper cleaning and sanitary maintenance of such equipment, adjacent equipment, and floor and wall surfaces in the immediate vicinity. Floor-mounted equipment, not easily moved, must be sealed to the floor or elevated on legs that provide at least a 6-inch clearance (aboard ship, 8 inches) between the floor and equipment. However, if no part of the floor under the floor mounted equipment is more than 6 inches from cleaning access, the clearance space may be only 4 inches.

c. All food service spaces and equipment must be free from salt water connections, cross connections with a nonpotable water supply, and submerged fresh water inlets. Exceptions to the salt water requirement are those shipboard sculleries which contain food waste disposers that have been specifically approved by CHBUMED to use salt water during the food waste grinding or pulping process and approved refrigeration units which use salt water.

d. Surfaces of Equipment or Utensils:

(1) Food Contact Surfaces. Food contact surfaces will be of materials which are smooth, corrosion resistant, nontoxic, stable, and nonabsorbent under use conditions and will not impart

an odor, color or taste, nor contribute to adulteration of food. All joints and seams in the food contact zone will be sealed and smooth at the surfaces being joined.

(2) Splash Contact Surfaces. Food splash zone materials will be smooth, easily cleanable, and corrosion resistant, or rendered corrosion resistant with a material which is non-cracking and nonchipping. Paint will not be used except for surfaces which are normally dry. Lead base paint will not be used. If food service equipment is to be refinished, only the manufacturer's standard practice will be used.

(3) Nonfood Zone. Exposed screws, projecting screws, studs and rivet heads will be used only when other fastening methods are impractical. In areas subject to cleaning; projections, ledges and recesses will be minimized. The ends of all hollow sections of reinforcing and framing members will be closed.

4-2 WARE WASHING METHODS

4-2.19 **MANUAL WARE WASHING**
4-2.20 **ALTERNATIVE MANUAL METHODS**

4-2.1 Introduction

a. A sufficient supply of utensils must be available to prevent the recycling of inadequately cleaned, wet or hot tableware and utensils.

b. Care must be taken to prevent contamination of clean and sanitized tableware and utensils by eliminating the cross handling of soiled and clean items and protecting the clean items from splashes or aerosols. Ware washing areas must be designed to direct the flow of tableware and utensils from the soiled areas (scraping and preflushing) to clean areas (drying area).

c. Sanitized tableware and utensils must be air dried and stored in a manner that protects the tableware and utensils from contamination resulting from unnecessary handling, dust and splashes.

4-2.2 Steps of the Ware washing Process

The six steps in the ware washing process are:

a. Sorting

b. Scraping

c. Washing

d. Rinsing

e. Sanitizing

f. Air Drying

4-2.3 Ware Washing Machines, Manufacturers' Operating Instructions

a. A ware washing machine and its auxiliary components shall be operated by the machine's data plate and other manufacturer's instructions.

b. A ware washing machine's conveyor speed or automatic cycle times shall be maintained accurately timed by the manufacturer's specifications.

4-2.4 Ware Washing Machine, Data Plate Operating Specifications

Ware washing machines will be provided with an easily accessible and readable data plate affixed to the machine by the manufacturer that indicates the machine's design and operating specifications including the:

a. Temperatures required for washing, rinsing, and sanitizing;

b. Pressure required for the fresh water sanitizing rinse unless the machine is designed to use only a pumped sanitizing rinse; and

c. Conveyor speed for conveyor machines or cycle time for stationary rack machines.

4-2.5 Ware Washing Machines, Internal Baffles

Ware washing machine wash and rinse tanks shall be equipped with baffles, curtains, or other means to minimize internal cross contamination of the solutions in wash and rinse tanks.

4-2.6 Ware Washing Machines, Temperature Measuring Devices

Ware washing machines will be equipped with a temperature measuring device that indicates the temperature of the water:

a. In each wash and rinse tank; and

b. As the water enters the hot water sanitizing final rinse manifold or in the chemical sanitizing solution tank.

4-2.7 Manual Ware Washing Equipment, Heaters and Baskets

If hot water is used for sanitization in manual ware washing operations, the sanitizing compartment of the sink shall be:

a. Designed with an integral heating device that is capable of maintaining water at a temperature not less than 171°F (77°C); and

b. Provided with a rack or basket to allow complete immersion of equipment and utensils into the hot water.

4-2.8 Ware Washing Machines, Flow Pressure Device

a. Ware washing machines that provide a fresh hot water sanitizing rinse will be equipped with a pressure gauge or similar device such as a transducer that measures and displays the water pressure in the supply line immediately before entering the ware washing machine; and

b. If the flow pressure measuring device is upstream of the fresh hot water sanitizing rinse control valve, the device will be mounted in a 6.4 millimeter or one-fourth inch iron pipe size (IPS) valve.

c. Paragraphs (a) and (b) above do not apply to a machine that uses only a pumped or recirculated sanitizing rinse.

4-2.9 Ware Washing Sinks and Drainboards, Self-draining

Sinks and drainboards of ware washing sinks and machines shall be self-draining.

4-2.10 Sanitizing Solutions, Testing Devices

The concentration of sanitizing solution(s) shall be verified with a test kit or other device that accurately measures the concentration in mg/L or ppm.

4-2.11 Ware Washing Equipment, Cleaning Frequency

Ware washing machines; the compartments of sinks, basins, or other receptacles used for washing and rinsing equipment and utensils will be cleaned:

a. Before use;

b. Throughout the day at a frequency necessary to prevent recontamination of equipment and utensils and to ensure the equipment performs its intended function; and

c. At least every 24 hours.

4-2.12 Ware Washing Equipment, Clean Solutions

The wash, rinse, and sanitize solutions shall be maintained free of food or other organic matter that affect solution performance.

4-2.13 Manual Ware Washing Equipment, Wash Solution Temperature

The temperature of the wash solution in manual ware washing equipment shall be maintained at not less than 110°F (43°C) unless a different temperature is specified on the cleaning agent manufacturer's label instructions.

4-2.14 Mechanical Ware Washing Equipment, Wash Solution Temperature

a. The temperature of the wash solution in spray type warewashers that use hot water to sanitize may not be less than:

(1) For a single tank, stationary rack, single temperature machine, 165°F (74°C);

(2) For a single tank, conveyor, dual temperature machine, 160°F (71°C);

(3) For a stationary rack, dual temperature machine, 150°F (66°C); or

(4) For a multitank, conveyor, multitemperature machine, 150°F (66°C).

b. The temperature of the wash solution in spray type warewashers that use chemicals to sanitize may not be less than 120°F (49°C).

4-2.15 Manual Ware Washing Equipment, Hot Water Sanitization Temperatures

If immersion in hot water is used for sanitizing in a manual operation, the temperature of the water shall be maintained at 171° F (77° C) or above.

4-2.16 Mechanical Ware Washing Equipment, Hot Water Sanitization Temperatures

a. In a mechanical operation, the temperature of the fresh hot water sanitizing rinse as it enters the manifold may not be more than 194°F (90°C), or less than:

(1) For a single tank, stationary rack, single temperature machine, 165°F (74°C); or

b. For all other machines, 180°F (82°C).

4-2.17 Mechanical Ware Washing Equipment, Sanitization Pressure

The flow pressure of the fresh hot water sanitizing rinse in a ware washing machine may not be less than 15 pounds per square inch (100 kilopascals) or more than 25 pounds per square inch (170 kilopascals) as measured in the water line immediately upstream from the fresh hot water sanitizing rinse control valve.

4-2.18 Temperature Measuring Devices

Temperature measuring devices shall be calibrated in by the manufacturer's specifications as necessary to ensure their accuracy. Each device will be accurate to ± 3°F (± 1.5°C).

4-2.19 Manual Ware Washing

4-2.19.1 Equipment

a. A three-compartment deep sink is basic for proper manual ware washing procedures. If a three-compartment sink cannot be provided, a two-compartment sink and/or other containers, e.g., large kettle, etc., may be used provided adequate provisions are made to accomplish the six steps of the ware washing process.

b. Accessory equipment and supplies required for proper manual ware washing include a booster heater for the final rinse sink, thermometers for monitoring the final rinse water temperatures, a drip and drain basket and/or arm length rubber gloves for the final rinse, approved brushes, hand ware washing compounds, and sanitizing agents.

4-2.19.2 Field Messing

Manual ware washing methods are contained in NAVMED P-5010 Chapter 9, Preventive Medicine for Ground Forces.

4-2.20 Alternative Manual Methods

When ware washing in sinks or ware washing machines is impractical, ware washing will be done by alternate methods, as approved by the PMA:

a. Disassemble as necessary to permit access to all parts;

b. Scrape or rough clean to remove gross food particle accumulation;

c. Clean the equipment using a high pressure detergent spray, a line pressure spray detergent foam or a swabbing/brushing procedure using a detergent solution.

d. Rinse the washed equipment with potable water or detergent sanitizer solution.

e. Manually swab or pressure spray the equipment with the concentration of detergent sanitizer or chemical sanitizer specified on the label.

4-3 WARE WASHING AGENTS

a. Detergents. The efficiency of the detergent is affected by the degree of hardness of the water. Different detergents are available for hard and soft waters. Preference should be given to a detergent demonstrated to be effective with the particular water supply used. Water produced by a ship's distilling plants is normally very soft.

b. Detergent Feeding. Detergent must be added to ware washing machines. It can be added manually; however, automatic dispensers are highly recommended. The proper amount of detergent will depend on the capacity of the tank and hardness of the water. Detergent should be added to the machine as directed in the manufacturer's recommendations.

c. Unauthorized Ware Washing Agents. General purpose cleaning agents which do not specifically state, on the label, the intended use is for food contact surfaces will not be used for washing tableware and utensils. Manual ware washing compounds must not be used in ware washing machines and ware washing machine detergent will not be used for manual ware washing.

4-4 SANITIZING AGENTS (DISINFECTANTS)

4-4.1 MANUAL AND MECHANICAL WARE WASHING EQUIPMENT, CHEMICAL SANITIZATION TEMPERATURE, pH, CONCENTRATION, AND HARDNESS
4-4.2 MANUAL WARE WASHING EQUIPMENT, CHEMICAL SANITIZATION USING DETERGENT SANITIZERS
4-4.3 WARE WASHING EQUIPMENT, DETERMINING CHEMICAL SANITIZER CONCENTRATION
4-4.4 HOT WATER AND CHEMICAL SANITIZING
4-4.5 STRENGTH DETERMINATIONS

4-4.1 Manual and Mechanical Ware Washing Equipment, Chemical Sanitization Temperature, pH, Concentration, And Hardness

A chemical sanitizer used in a sanitizing solution for a manual or mechanical operation shall be used per the EPA-Approved manufacturer's label use instructions and as follows:

a. A chlorine solution shall have a minimum temperature based on the concentration and pH of the solution as listed in table 1-5.

Table 1- 5. Requirements for a 10 second chlorine rinse

Minimum Chlorine Concentration	Minimum Water Temperature	
mg/L (ppm)	pH 10 or less °F	pH 8 or less °F
25	120	120
50	100	75
100	55	55

b. An iodine solution shall have a:

(1) Minimum temperature of 75°F (24°C),

(2) A pH of 5.0 or less or a pH no higher than the level for which the manufacturer specifies the solution is effective; and

(3) Concentration between 12.5 mg/L and 25 mg/L;

c. A quaternary ammonium compound solution shall:

(1) Have a minimum temperature of 75° F (24°C),

(2) Have a concentration as required in 21 CFR 178.1010 sanitizing solutions and as indicated by the manufacturer's use directions included in the labeling, and

(3) Be used only in water with 500 mg/L hardness or less, or in water having a hardness no greater than specified by the manufacturer's label.

d. Other chemical sanitizers approved by the PMA may be used if they are applied per the manufacturer's use directions included in the labeling.

4-4.2 Manual Ware Washing Equipment, Chemical Sanitization

If a detergent sanitizer is used to sanitize in a cleaning and sanitizing procedure where there is no distinct water rinse between the washing and sanitizing steps, the agent applied in the sanitizing step shall be the same detergent sanitizer that is used in the washing step.

4-4.3 Ware Washing Equipment, Determining Chemical Sanitizer Concentration

Concentration of the sanitizing solution shall be accurately determined by using a test kit or other device.

4-4.4 Hot Water and Chemical Sanitizing

After washing, equipment food contact surfaces and utensils shall be sanitized in:

a. Hot water manual operations by immersion for at least 30 seconds as specified under section 4-2.15;

b. Hot water mechanical operations by being cycled through equipment that is set up as specified under section 4-2.3 and 4-2.16 and 4-2.17 and achieving a utensil surface temperature of 160°F (71°C) as measured by an irreversible registering temperature indicator; or

c. Chemical manual or mechanical operations, including the application of sanitizing chemicals by immersion, manual swabbing, brushing, or pressure spraying methods, using a solution as specified under section 4-4.1 by providing:

(1) An exposure time of at least 10 seconds for a chlorine solution,

(2) An exposure time of at least 30 seconds for other chemical sanitizer solutions, or

(3) An exposure time used in relationship with a combination of temperature, concentration, and pH that yields sanitization as defined in this chapter.

4-4.5 Strength Determinations

Table 1-6 indicates the amount (in ounces) of chlorine compound required for initial concentration of 200 ppm free available chlorine(FAC) and the amount (in ounces) of iodine type disinfectant required for an initial dilution of 25 ppm. Always follow directions on the container label.

a. Table 1-6 is a guide to determine the proper amount of sanitizing solution for each amount of water. For specific guidelines follow the manufacturers' recommendation.

Table 1-6. Ounces of agent required for chemical sanitizing solution

Gallons of Water	5	10	15	20	25
Required Ounces of Agent:					
Sodium Hypochlorite Liquid 5% available chlorine to make 200 ppm solution	2.5	5.0	7.5	10.0	12.5
Sodium Hypochlorite Liquid 10% available chlorine to make 200 ppm solution	1.25	2.5	3.75	5.0	6.25
Disinfectant, Liquid, Iodine Type to make 25 ppm solution	1.0	2.0	3.0	4.0	5.0
Note: Three teaspoons equal 1 tablespoon. Two tablespoons equal 1 ounce. Eight ounces equal 1 cup.					

4-5 AUTOMATIC COLD WATER GLASS WASHER

a. Bars in military clubs and messes may use automatic cold water glass washers provided they meet NSF standards and other provisions discussed in this chapter.

b. When inspecting bar areas, the PMA must ensure approved products are used and the glass washer is being operated as recommended by the machine manufacturer's operating instructions.

4-6 MESSING FACILITY SANITATION

4-6.1 DAILY INSPECTION OF TABLEWARE
4-6.2 MESSING FACILITY TABLES
4-6.3 PEST CONTROL SURVEYS

4-6.1 Daily Inspection of Tableware

Tableware must be inspected daily by supervisory personnel. Forks with broken or badly bent tines must be immediately removed from use and surveyed. Badly worn, rough edge spoons, chipped or cracked cups, dishes, glasses, and other dinnerware will be surveyed and discarded on detection. These items should be removed during the sorting procedure, prior to ware washing.

4-6.2 Messing Facility Tables

During the meal period and prior to closing each day, tables and seating areas will be cleaned using the "two pan method" with one pan containing a mild detergent and water solution and the second pan containing a rinse solution.

4-6.3 Pest Control Surveys

During food sanitation inspections the PMA shall conduct pest control surveys. Specific procedures for accomplishing surveys and establishing proper control techniques are contained in the Shipboard Pest Control Manual, BUMEDINST 6250.13 or superseding instruction, and NAVMED P-5010, Chapter 8, Medical Entomology and Pest Control Technology of this manual.

4-7 UTENSILS AND EQUIPMENT

4-7.1 Food Service Equipment

Food service equipment must be maintained in good operating condition and serviced when required. Equipment which is no longer used or is unserviceable, must be removed from the galley spaces. Utensils and food contact surfaces of equipment must be cleaned and sanitized.

a. Utensils and equipment used in production line, processing, or continuous operations must be cleaned and sanitized as follows:

(1) Each time there is a change in processing between types of raw animal products such as beef, fish, lamb, pork, and poultry;

(2) Each time there is a change from raw to ready-to-eat foods;

(3) After any substantial interruption of operations in which contamination may have occurred;

(4) Throughout the day at intervals necessitated by food temperature, type of food, and food particle accumulation;

(5) After final use each working day.

b. Utensils and food contact surfaces of equipment used in noncontinuous food operations must be cleaned and sanitized:

(1) After each use;

(2) After a substantial interruption of operations in which contamination may have occurred.

4-7.2 Steam Jacketed Kettles and Urns

a. Steam jacketed kettles and urns must be scrubbed inside and outside after each use with a scrub brush and detergent solution followed by a rinse with potable water and a sanitizing rinse of either hot water or chemical sanitizing rinse. See section 4-4.4 above, NSTM 9340 or NAVSUP PUB 421 Appendix B for details.

b. The PMA should ensure steam jacketed kettles:

(1) Are equipped with functional steam safety release valves.

(2) Have at least 18" long chains on the steam safety relief valves.

(3) Have steam discharge piped down to kettle coamings and directed away from operators.

(4) Steam and water piping are protected by a perforated corrosion resistant steel (CRES) or aluminum shield which surrounds the pipe with approximately ½" standoff from the pipe.

(5) Are in compliance with hydrostatic testing periodicity.

4-7.3 Can Openers

Cutting or piercing parts of can openers must be readily removable for cleaning and for replacement.

4-7.4 Wooden Food Service Equipment

a. Except as specified below, wood and wood wicker may not be used as a food contact surface.

b. Hard maple or an equivalently hard, close-grained wood may be used for:

(1) Cutting boards; cutting blocks; bakers' tables; and utensils such as rolling pins, doughnut dowels, salad bowls, and chopsticks;

(2) Wooden paddles used in confectionery operations for pressure scraping kettles when manually preparing confections at a temperature of 110°C (230°F) or above.

c. Whole, uncut, raw fruits and vegetables, and nuts in the shell may be kept in the wood shipping containers in which they were received.

d. If the nature of the food requires removal of rinds, peels, husks, or shell before consumption, the whole, uncut, raw food may be kept in:

(1) Untreated wood containers;

(2) Treated wood containers if the containers are treated with a preservative that meets the requirements specified in 21 CFR 178.3800, Preservatives for Wood.

4-7.5 Cutting Boards

Cutting boards must be cleaned and sanitized after each use. This includes those occasions when different meat products or the same meat products (after a substantial interruption) are to come in contact with the same cutting board. Cleaning and sanitizing may be accomplished manually or by machine. Cutting boards must not contain cut marks that impede cleaning and sanitizing. Cutting boards which are scored or cut should be resurfaced or discarded.

4-7.6 Sponges and Cleaning Cloths

All sponges and cleaning cloths used for cleaning galley utensils and equipment must be washed and sanitized after each meal period. Sponges may not be used in contact with cleaned and sanitized or in use food contact surfaces.

4-7.7 Metal Polish

Metal polish is not approved for use on food contact surfaces. When metal cleaners and polishes are used for nonfood contact surfaces, food products, utensils, dinnerware and food packaging materials must be removed from the space or carefully protected. All odors associated with these compounds must be dissipated before food products, etc., are reexposed in the space.

4-7.8 Steel Wool

The use of steel wool for cleaning equipment, utensils, and other food contact surfaces is prohibited. Metal sponges (carried in the supply system) may be used, but must be discarded when they show signs of wear.

4-7.9 Utensils

a. All utensils used in food preparation or service shall be cleaned and sanitized by manual or machine ware washing after each use.

b. A food dispensing utensil shall be available for each food item on a self-service unit such as a buffet or salad bar.

c. All "in use" food dispensing utensils shall be properly stored to prevent contamination of the food item.

4-7.10 Single Service and Single Use Articles

a. Single service and single use articles are required when cleaning and sanitizing of regular utensils cannot be properly accomplished.

b. Single service and single use articles may not be reused.

c. Disposable flatware shall be dispensed in a sanitary manner.

4-7.11 Storage Equipment

Storage shelves, racks, cabinets, or drawers in food preparation or serving areas must be kept free from food residues and debris.

Liners (aluminum foil and wax paper) should not be used in drawers or on shelving because they allow food to accumulate and provide insect harborages.

4-7.12 Microwave Ovens

a. Microwave ovens shall meet the safety standards specified in 21 CFR 1030.10 Microwave Ovens.

b. Microwave ovens must be cleaned daily or as often as necessary.

4-8 HAZARDOUS METALLIC COATINGS

a. Only materials which meet NSF Standard No. 2 or its equivalent may be used in the construction of food service utensils and equipment.

b. Enameled ware, galvanized metal, copper, cadmium, antimony, zinc or tin utensils will not be used for food contact surfaces. The soluble salts and/or oxides of such heavy metals can cause abrupt and severe gastrointestinal symptoms, typically in a setting where foods or beverages of high acid content have reacted chemically with the metal containers in which they were prepared or stored.

c. Silver plated pitchers or bowls must not be used for holding or serving acidic food or beverages. Even minor pitting or scratching exposes the underlying copper to the leaching action of the acid food or drink. Sufficient copper ions may be present in such beverages to result in copper poisoning. Stainless steel, plastic or glass containers are recommended for dispensing acidic food and beverages.

CHAPTER 1, FOOD SAFETY

Section V. STRUCTURAL REQUIREMENTS AND SANITARY CONTROLS

5-1 INTRODUCTION

Basic structural standards in food establishments shall conform to the requirements in this chapter, the Department of Defense Construction Criteria Manual, DoD 4270.1M, and NAVSEA S9-AAO-AA-SPN-010/GEN-SPEC, General Specifications For Ships of the United States Navy, whichever is applicable. The installation PMA should be involved with design review of all new construction and rehabilitation of Navy and Marine Corps food establishments at shore stations.

5-2 FLOORS, WALLS, AND CEILINGS

5-2.1 Floors (Decks)

a. The floors in all food preparation areas, food storage areas, ware washing areas, walk-in refrigerators and freezers, dressing rooms, locker rooms, toilet rooms, vestibules, inside refuse storage rooms, and food vending machine areas must be constructed of smooth durable, sealed concrete, terrazzo, quarry tile, ceramic tile, durable grades of vinyl/plastic tile, vinyl or plastic linoleum, or tight-fitting plastic impregnated wood.

b. Adequate drains must be provided in floors which are flushed with water for cleaning or which receive discharges of water or other fluid wastes from equipment. Floors will be graded to drain.

c. Floors which are water flushed, receive discharges of water or other fluid wastes, or are in areas where pressure spray methods of cleaning are used must be made of nonabsorbent materials.

d. Carpeting may be used on the floors of dining areas. It must be of closely woven, easily cleanable material and installed tightly against the wall under the coaming or installed away from the wall with a space between the carpet and the wall that permits easy cleaning of the space with the edges of the carpet secured by metal stripping or some other means. Carpeting must not be installed as a floor covering in food preparation areas, food storage areas, ware washing areas, hand washing areas and toilet room areas where urinals and toilets are located.

e. Supplemental flooring such as nonskid surfaces, mats, and duckboards must be designed to be easily cleanable, constructed of nonabsorbent material and be grease resistant in areas exposed to large amounts of grease and water. When used as a mat in areas not exposed to large amounts of grease and water, they should be constructed of rubber/plastic backed closely woven material. Supplemental flooring should be NSF listed or equivalent.

f. All floors must be kept clean.

5-2.2 Walls and Ceilings (Bulkheads and Overheads)

a. The walls, wall coverings and ceilings in areas listed in section 5-2.1 must be nonabsorbent.

b. When concrete, pumice blocks, or bricks are used for interior wall construction, they must be finished and sealed to provide a nonabsorbent, easily cleanable surface.

c. Wall and ceiling covering materials must be attached and sealed so they are easily cleanable.

d. Light fixtures, vent covers, wall mounted fans, decorative materials and similar attachments to walls and ceilings must be easily cleanable.

e. Studs, joists, rafters and piping in shore based facilities will not be exposed in areas listed in section 5-2.1, except that studs, joists, and rafters may be exposed in the overhead protection of outside service areas. Piping may be exposed aboard ship if it is finished to provide an easily cleanable surface.

5-3 LIGHTING AND VENTILATION

5-3.1 LIGHTING
5-3.2 VENTILATION

5-3.1 Lighting

a. At least 10-foot candles of lighting must be available at any time in all food service areas and rooms including walk-in units.

b. The lighting on food preparation and ware washing work surfaces must be at least 50 foot candles.

c. The lighting in packaged food and fresh produce sales areas, hand washing areas, ware washing areas, equipment and utensil storage areas, and toilet areas must be at least 20 foot candles at a distance of 30 inches from the floor.

d. Shielding to protect food from broken glass must be provided for all artificial lighting fixtures located over, by, or within food storage preparation, service, and display facilities and areas where food service equipment is cleaned and stored.

5-3.2 Ventilation

a. Food service establishments must be ventilated, mechanically if necessary, to be free of excessive heat, steam, condensation, vapors, obnoxious odors, smoke, and fumes.

b. If necessary, all rooms, areas, and equipment from which aerosols, offensive odors, or noxious gases or vapors may originate must be vented effectively to the outside.

c. Intake air ducts will be designed and maintained to prevent the entrance of dust, dirt, insects, and other contaminated materials.

d. Ventilation hoods and grease filters must be cleaned of dirt and grease as often as necessary, and at least weekly to avoid the danger of fire. Filters which cannot be adequately cleaned must be replaced.

e. On surface ships, General Specifications for Ships of the United States(NAVSEA S9AAO-AASPN-010/GEN-SPEC) requires a ventilation grease interceptor hood be installed over each steam kettle, roast oven, bake oven, convection oven, griddle, fry kettle, doughnut fryer, deep fat fryer and range. These interceptors are equipped with a semiautomatic detergent cleaning system. The hood serving the deep fat fryer and doughnut fryer must be fitted with a fire extinguishing system.

f. The interior of ventilation ducting must be cleaned periodically as required by the preventive maintenance system. Access plates must be provided as necessary to gain cleaning access to duct work.

g. Temperatures in shipboard spaces that equal or exceed 100°F must be reported to the Medical Department immediately.

5-4 DRESSING ROOMS AND LOCKERS

a. Dressing rooms or designated dressing areas must be provided outside food preparation, storage, and serving areas, equipment storage areas, and sculleries when employees routinely change their clothes within the establishment.

b. Adequate lockers or other suitable facilities must be provided and used for the storage of employees' clothing and belongings.

c. Dressing rooms, designated dressing areas, and lockers must be kept clean and orderly.

5-5 HOUSEKEEPING

5-5.1 General

The entire food service facility and all areas of the property used in connection with operation of the establishment must be kept neat, clean, and free of litter, refuse, and garbage.

5-5.2 Cleaning Methods

a. Dustless methods of cleaning must be used, such as wet cleaning, vacuum cleaning, mopping with treated mops, or sweeping using a broom with dust arresting compounds.

b. Sponges may not be used in contact with cleaned and sanitized or in use food contact surfaces.

5-5.3 Service Sinks or Curbed Cleaning Facility

a. The cleaning of mops and similar cleaning tools and materials, and the disposing of mop water and similar liquid wastes in food preparation sinks, hand washing facilities, and ware washing facilities is prohibited.

b. At least one service sink or curbed cleaning facility with a floor drain must be provided for cleaning mops and for the disposal of mop water and similar liquid waste.

5-5.4 Maintenance Equipment and Supplies

Maintenance and cleaning equipment and supplies such as brooms, mops, vacuum cleaners, soaps, disinfectants and similar equipment and supplies must be:

a. Stored so they do not contaminate food, equipment, utensils, or linens.

b. Stored in a space or area that is provided with adequate ventilation to prevent malodors and allow gear to dry.

c. Stored in an orderly manner that will facilitate cleaning of the maintenance equipment storage spaces.

5-5.5 Unnecessary Persons

Unnecessary persons in the food preparation or utensil washing area are prohibited. Controlled visits/tours may be authorized by the person in charge.

5-6 WATER SUPPLY AND SEWAGE DISPOSAL

5-6.1 Potable Water System

a. Ashore, adequate potable water for the needs of the food establishment must be provided from an approved source and meet the standards of NAVMEDCOMINST 6240.1 series and/or chapter 5 of this manual.

b. At sea, potable water standards can be found in chapter 6 of this manual and/or NSTM 533.

c. Hot and/or cold water under pressure must be provided to all fixtures and equipment that use potable water.

d. Plumbing, fixtures and equipment must be installed to preclude backflow into the potable water supply system (e.g., faucets on which hoses are attached must have a backflow prevention device). Other outlets must be protected by an air gap twice the effective opening of the potable water outlet diameter, unless the outlet is a distance less than three times the effective opening away from a wall or similar vertical surface, in which case the air gap must be three times the effective opening of the outlet. In no case will the air gap be less than one inch.

5-6.2 Steam

Steam used in contact with food and food contact surfaces must be free from any materials or additives other than those specified in 21 CFR 173.310. Currently, shipboard steam contains additives which are not acceptable for use with food and/or food contact surfaces.

5-6.3 Sewage

Ashore, all sewage wastes must be disposed through an approved community sewage treatment plant or an individual sewage disposal system which is sized, constructed, maintained and operated according to law. References include Chapter 7, NAVMED P-5010; OPNAVINST 5090.1; and NSTM 593.

5-6.4 Equipment Connections

a. Ware washing machines, refrigerators, steam kettles, potato peelers, and other similar equipment must not be directly connected to the wastewater system without an air gap between the equipment and the wastewater lines. Where permitted by law, a sink may have a direct connection provided the drain line is properly trapped. Ware washing machines may have direct connections between their waste outlets and the floor drain when the connection is on the inlet side and immediately adjacent to the floor drain trap, and the floor/deck drain is properly trapped and vented.

b. Ice making machines will have an air gap as specified in section 5-6.1(c) between the outlet and the drain's wastewater line.

5-7 TOILET AND LAVATORY FACILITIES

5-7.1 TOILET FACILITIES

5-7.2 HAND WASHING LAVATORY FACILITIES

5-7.1 Toilet Facilities

a. Toilet facilities must be conveniently located, adequate in number (see 29 CFR 1910.141(c)), and easily accessible to employees at all times. Installation will be as required by the DOD Construction Criteria Manual 4270.1-M or, in the case of afloat facilities, General Specifications for Ships of the U.S. Navy, Section 644f.

b. Water closets and urinals must be designed for easy cleaning.

c. Toilet rooms must be completely enclosed and must have tight-fitting, self-closing, solid doors which are kept closed except during cleaning and maintenance, or as required to assist the handicapped

d. Toilet rooms must not open directly into food preparation areas.

e. Toilet facilities, including vestibules, must be kept clean, free of objectionable odors, and in good repair. Adequate quantities of toilet tissue, hand towels and other supplies must be provided at all times. Easily cleanable receptacles must be provided for waste materials and sanitary napkins. All receptacles will be covered with self-closing lids.

f. The storage of food, equipment, utensils, and single service articles in the toilet rooms or vestibules is prohibited.

5-7.2 Hand Washing Lavatory Facilities

a. Hand washing facilities must be conveniently located to permit use by employees in food preparation and utensil washing areas and located in, or immediately adjacent to, toilet rooms or toilet room vestibules.

b. Each hand washing facility must be designed to provide tempered water through a mixing valve or combination faucet.

c. Any self-closing, slow closing or metering faucet must provide a flow of water for at least 15 seconds without the need to reactivate the faucet.

d. Steam mixing valves are prohibited at hand washing facilities.

e. Ample supplies of powdered or liquid soap in appropriate dispensers and proper hand drying equipment such as disposable paper towels and hot air hand dryers must be provided. The use of single service continuous cloth toweling is permitted provided it is dispensed from a cabinet that retracts all soiled toweling and bears the seal of the NSF or its equivalent. When disposable towels are used, a waste receptacle must be located at each hand washing facility or group of adjacent facilities.

f. Lavatories, soap dispensers, hand drying devices, and all other related facilities must be kept clean and in good repair.

g. In situations where food exposure is limited and hand washing facilities are not conveniently available, such as in some mobile or temporary food service facilities or at some vending machine locations, the PMA may approve chemically treated towelettes or other appropriately dispensed disinfectants for hand washing.

5-8 GARBAGE AND REFUSE DISPOSAL

5-8.1 Containers

a. Garbage and refuse must be kept in covered, durable, easily cleanable, insect and rodent resistant, leak proof, nonabsorbent containers that are maintained in good repair. Refuse containers manufactured from thermoplastic should be NSF listed or equivalent. Plastic bags and/or wet strength paper bags may be used to line containers. Refer to OPNNAVINST 5090 series for guidance on disposal of plastic materials at sea. Plastic rubber trash containers are prohibited for use on ships.

b. Refuse compactors and compactor systems should be NSF listed or equivalent. Containers and compactors must be easily cleanable and provided with tight-fitting lids, doors or covers. They must be kept closed when not in actual use. Drain plugs, where applicable, must be in place at all times, except during cleaning.

c. Sufficient numbers of garbage and refuse containers must be provided to prevent overfilling. The containers must be emptied as necessary during operations and at the close of each working day. After being emptied, each container must be thoroughly cleaned inside and outside, in a manner which will not cause contamination of food, equipment, utensils, or food preparation areas or, if cleaned outside, create a nuisance. Suitable facilities, can washer, detergent, and hot water or steam mixing valves must be provided and used for cleaning refuse equipment and containers.

d. Soiled refuse equipment and containers must be cleaned at a frequency to prevent them from becoming insect and rodent attractors and a source of contamination.

5.8.2 Storage

a. Garbage and refuse on the premises must be stored in a manner that makes it inaccessible to insects and rodents. Outside storage of plastic containers which are not rodent resistant, e.g., unprotected plastic bags, paper bags or baled units which contain refuse, is prohibited. Cardboard or other packaging material not containing food wastes may be stored outside without being in a covered container.

b. When inside storage rooms and areas are used they must be constructed to meet the criteria in Section 5-2 and maintained in a manner which prevents or minimizes the accumulation of filth, the occurrence of odors and the existence of vermin.

c. When possible, outside storage areas or enclosures must not be located within 100 feet of the food establishment. The areas must be large enough to store the garbage and refuse containers that accumulate and must be kept clean and in good repair. The storage surface must be constructed of nonabsorbent material such as concrete, be smooth and be sloped to drain. The enclosure, if used, must be constructed of durable and cleanable materials.

d. Dumpsters and other containers used to store garbage must be thoroughly cleaned with high pressure water or steam as required. Cleaning twice each week is recommended whenever flies are present.

5.8.3 Disposal

a. Garbage produced in large volume such as produced at messes, clubs, cafeterias and commissaries should be removed from the premises at least daily by a transport vehicle, or by portable containers which are constructed, maintained and operated according to applicable law.

b. Food waste disposers or grinders may be used for garbage disposal provided they are designed and/or located in a manner which precludes contamination of food contact surfaces as a result of splash and aerosol generation. When approved by CHBUMED, shipboard waste disposers located in separate sculleries may have the capability for either fresh or salt water flushing. Proper warning plates and operating instructions must be posted (see GENSPEC, Section 593).

c. Refuse must be removed as often as necessary to prevent nuisance or hazardous conditions. It must be disposed of by an approved public or private community refuse facility or by an individual refuse facility which is sized, constructed, maintained and operated according to law.

d. Garbage disposal as feed for hogs is prohibited in many States. This method of disposal must conform to local and State laws.

e. Disposal of garbage from vessels returning to CONUS from foreign ports must comply with requirements of SECNAVINST 6210.2 and NAVSUP PUB 486, Volume 1, Article 4033.

5-9 INSECT AND RODENT CONTROL

5-9.1 Stored Products Pests

Guidelines for insect infestation of subsistence are contained in Chapter 8, NAVMED P-5010, Medical Entomology and MIL-STD-904A.

5-9.2 Insect and Rodent Access

a. Food service establishment openings to the outside must be effectively protected against the entrance of rodents and insects. The establishment will have no holes and other gaps along the floors, walls, and ceilings. Outside openings will be controlled by the use of self-closing tight-fitting doors and/or closed tight-fitting windows. Outside openings that are kept open for ventilation, deliveries or other purposes will have screens, air curtains or other means of protection. Screens must be tight-fitting, free of breaks or tears, and not less than 16 mesh to the inch of screen.

b. Screens are not required in air-conditioned food service spaces where windows or portholes are sealed closed. Air curtains must meet the standards of NSF Standard No.37 or be equivalent. Further guidance is available in the NAVMED P-5010 Chapter 8 and OPNAVINST 6250.4A.

5-9.3 Pest Control Operations

Only certified pest control professionals are allowed to conduct pest control operations except for the use of approved bait stations.

5-10 POISONOUS OR TOXIC MATERIALS

5-10.1 Separation

All poisonous or toxic materials shall be stored so not to contaminate food, equipment, utensils, linens, and single service and single use articles.

5-10.2 Conditions of use

All poisonous or toxic materials shall be properly labeled with the manufacturer's directions. Additional restrictions may be established by the regulatory authority.

5-10.3 Pesticides

Pesticides shall be stored outside food service spaces.

Section VI. INSPECTION REPORTING PROCEDURES

6-1 FREQUENCY OF INSPECTION

6-1.1 Standard Frequency

The PMA will inspect all food establishments at least once each month unless specifically exempted by the installation regulatory authority. When a food establishment exceeds critical violation limits the PMA must promptly notify the commanding officer and increase the frequency of inspections for the food establishment until the compliance history significantly improves. Special requests by management for more frequent inspections by the PMA should be given favorable consideration as the workload permits.

6-1.2 Exemptions

Exemptions from once a month inspection requirement may be granted by the installation PMA to food establishments that demonstrate by past performance, current training, and effective management the exemption will most probably not adversely affect overall sanitary conditions. In all cases Navy and Marine Corps food establishments must be inspected at least once each quarter. Written exemptions are not required.

6-2 REPORT OF INSPECTION

6-2.1 Inspection Form

Navy and Marine Corps food establishments must be inspected by the PMA in company with the person in charge or their designated representative. The findings of the PMA must be recorded on the Food Establishment Inspection Report. This form is included in Appendix C of this chapter.

6-2.2 Inspection Form Distribution

The completed Food Establishment Inspection Report will be distributed as follows:

a. Original to the commanding officer having direct responsibility for the food establishment.

b. Copy to the person in charge.

c. Retain a file copy for the PMA.

6-2.3 Inspection Guide

The inspection guide is exhibited in Appendix C and can be used as a reference checklist to remind inspectors and food establishments of the major inspection areas.

6-3 FOOD ESTABLISHMENT INSPECTION REPORT

6-3.1 Introduction

When preparing the Food Establishment Inspection Report, NAVMED 6240/1, enter the data on the report form in the appropriate field. Use continuation pages to give a full description of the conditions found in the establishment.

6-3.2 Administrative Data

a. Enter the administrative data to clearly identify the food establishment and update the information when necessary. Use abbreviations where they do not interfere with reliable identification of the establishment.

b. Use the Inspection Type (Insp. Type) when recording the reason for the inspection. Use the Time blank for recording the time of day the inspection was made.

c. Use the Risk Category Section to designate the Food Establishment's Risk Type Category.

6-3.3 Violation Data

a. Record inspection findings on the NAVMED 6240/1 to detail the violations found during the inspection of the establishment. The form is designed to maximize the opportunity for capturing relevant information about the violations found at the time of the inspection. Use as many of the rows of the violation description section as are needed to describe the violation.

b. Indicate critical violations in the **first column, Category,** using an X. Always list the critical violations first for emphasis. Leave a blank line between individual violations cited.

c. Note repeat violations with an X in the **second column, Repeat.** Repeat items are those that were in violation on the last inspection. Indicating in this column when the original violation occurred may also be helpful.

d. Record specific NAVMED P-5010-1 section references in the **third column, Code References.** The Food Service Inspection Guide, **List of Frequent Discrepancies,** provides the basis for the noted violation and helps the person in charge to find the actual NAVMED P-5010-1 requirement. It is important to standardize inspectors in their accurate citing of the NAVMED P-5010-1. Succinctly provide the specifics of the observed violation in the **fourth column, Violation Description/Remarks/Corrections.** Record any explanations or other data, including the fact that a correction was made during the inspection. Use as many lines as necessary to explain the details of the violation. Legibility is important.

6-3.4 Risk Categorization of Food Establishments

a. Studies have shown a relationship between types of food served, preparation steps, volume of food, population served, previous compliance history and food borne illness. Each PMA will set a fixed risk category for each food establishment operating in their area of responsibility.

b. The rational allocation of inspection resources to target the highest risk establishments with more inspection time and the lowest risk establishments with the least is an HACCP approach concept. Risk categorization allows establishments to be ranked by considering risk factors and creating a variable inspection frequency for each category. An example of risk categorization and types of facilities is shown in Table 1-7.

Table 1-7. Risk categorization of food establishments

RISK TYPE	RISK TYPE CATEGORY DESCRIPTION	FACILITY TYPE
1	Prepackaged nonpotentially hazardous foods only. Limited preparation of non-potentially hazardous foods only.	AROs
2	Limited menu (1 or 2 main items). Pre-packaged raw ingredients are cooked or prepared to order. Retail food operations exclude deli or seafood departments. Raw ingredients require minimal assembly. Most products are cooked/prepared and served immediately. Hot and cold holding of potentially hazardous foods is restricted to single meal service. Preparation processes requiring cooking, cooling, and reheating are limited to 1 or 2 potentially hazardous foods.	HOT DOG TRAILER SMALL DELI
3	Extensive handling of raw ingredients. Preparation process includes the cooking, cooling, and reheating of potentially hazardous foods. A variety of processes require hot and cold holding of potentially hazardous food. Advance preparation for next day service is limited to 2 or 3 items. Retail food operations include deli and seafood departments. Establishments doing food processing at retail.	LARGE DELI SMALL CLUB
4	Extensive handling of raw ingredients. Preparation processes include the cooking, cooling, and reheating of potentially hazardous foods. A variety of processes require hot and cold holding of potentially hazardous foods. Food processes include advanced preparation for next-day service. Category would also include those facilities whose primary service population is immunocompromised.	FULL SERVICE FACILITIES (Shore galleys, ship and submarine galleys)

c. Previous compliance history should also be considered when establishing inspection frequency. Nonconformance with critical code items or HACCP plan requirements may move an establishment up into more frequent inspections until a record of more consistent compliance is achieved.

d. There is a wide variety of methods for assigning establishments to risk categories. The simplest method for that jurisdiction is often the best.

e. Resources need to be allocated for seasonal and temporary food establishment operations. Frequently, this involves scheduling inspections on weekends and during evening hours.

f. It may be useful to schedule a number of inspections during the evening hours to get a more balanced view of certain food operations.

g. One or more of the routine inspections may be replaced with such alternatives as a full-scale HACCP study, or a staff training session.

6-3.5 Types of Inspections

a. Inspections are generally unannounced to obtain a more accurate assessment of normal operating practices and conditions. Exceptions include construction and preoperational inspections, HACCP studies, and follow up inspections, requiring the presence of specific personnel from the establishment. Full documentation should be maintained on each inspection as a part of the establishment's official agency record.

b. Inspections determine the food establishment's compliance with the NAVMED P-5010-1. These inspections may be categorized by purpose such as:

(1) **Pre-operational Inspection**

(a) A pre-operational inspection shall be conducted to ensure the establishment is built or remodeled per the approved plans and specifications. It is helpful to have plans and specification documents available during the inspection.

(2) **Routine Inspection**

(a) A full review of the food establishment operations and facilities and their impact on food safety is conducted. This includes assessment of food employee and management health, practices, and knowledge of food safety; food flows, source, storage, thawing, preparation (including cooking temperatures and times) and postpreparation processes; equipment and facility construction; cleaning and sanitizing processes; water sources; sewage disposal; and vermin control.

(b) Detailed reports are prepared at the conclusion of each inspection and presented to the person in charge. Non-compliance is categorized as critical or noncritical. Repeat items are also noted. The NAVMED P-5010-1 section in violation is included in the report citation section.

(3) **Follow Up Inspection**

(a) PMA personnel shall verify that critical violations have been corrected at the time of inspection or within 10 days of the initial routine inspection. Follow up inspections should be briefer than the routine inspection, since they concentrate on the critical violations previously reported.

(b) Corrections and continued violations should be noted on an inspection report. Continued violations should be used to initiate further compliance actions. Time available for follow up inspections will vary between jurisdictions. The compliance strategy is more effective if those follow ups are mandated in a realistic fashion, taking available resources into account.

(4) **HACCP Inspection** (See Model HACCP Inspection Data Form in Appendix C)

(a) Establishments operating under a variance requiring a HACCP plan are inspected differently. HACCP critical limits must be routinely monitored and recorded by the establishment and elements of the plan must be verified by the inspector.

(b) Copies of the HACCP plan are useful during these inspections. Additional time may be necessary to fully assess the establishment's compliance with the HACCP plan. Verifying the maintenance of the required records is an important element of the HACCP inspection. Notation in the records of process deviations that occurred and corrective actions taken in response to those deviations should not be cited as adverse findings.

(5) **Complaint Inspection**

(a) Consumer complaints received by the PMA about a food establishment requires investigation. Quick response is required for complaints related to food borne illnesses. Speed is essential to preserve memories, food and environmental samples.

(b) HACCP principles can be used to supplement traditional procedures for investigation of food borne illness.

It helps focus the investigation on foods which have been epidemiologically linked with illness.

(c) Other foods should not be completely dismissed because as more becomes known about the causes of food borne illness, foods which may not have been historically linked to illnesses are being implicated.

(d) The charting of food product flows and the designation of critical control points can help delineate potential problems. If a hazard seems evident, the suspect product or process can be recreated with the cooperation of the establishment and the critical limits monitored.

(e) Consumer complaints about food establishments should be evaluated in terms of public health significance before scheduling inspections. For example, allegations about an establishment purchasing shellfish from an illegal source should receive a higher priority than unsanitary public restrooms.

6-4 ESTABLISHMENT SCORING

6-4.1 Introduction

a. Certain NAVMED P-5010-1 violations are imminent health hazards and require immediate action. Sewage backed up in a food preparation area is an example of an imminent health hazard. Imminent health hazards require immediate intervention and may require closure of the facility.

b. Critical items are NAVMED P-5010-1 violations more likely to contribute to food contamination, illness, or environmental degradation and represent substantial public health hazards.

c. The NAVMED P-5010-1 allows the PMA to use professional judgement regarding some of the violations to determine their seriousness based on the likelihood of an event occurring.

6-4.2 Scoring Methods

a. The Food Establishment Inspection Report is based on citing violations in two categories, critical and noncritical. Each of the violations are expected to be corrected within given timeframes. The score, which is the number of items in violation, is significant as an indicator of the overall control of the causes of food borne illness; however, there is no defined point at which a score translates into a significant health hazard. It is possible to have only one critical violation which has the potential for causing a food borne illness outbreak.

b. Fixed Categorization will be utilized to score establishments by using critical and non critical categories.

(1) **Fixed Categorization**

(a) In this method, a fixed number of maximum critical violations is selected for each category of establishments. The Table of Critical Violations (Table 1-8) illustrates one application of this method.

(b) The number of violations used may be adjusted to accommodate current levels of resources in the agency and varying levels of compliance at the command.

(c) When a food establishment exceeds one of the critical violation limits the PMA must promptly notify the commanding officer and the PMA will increase the frequency of inspections for the food establishment until compliance history significantly improves.

Table 1-8. Critical violation limits by facility type

Facility Type	Critical Violation Limits
1	2
2	4
3	7
4	7

6-4.3 Debiting Methodology

It is essential to standardize the inspection process. The following process specifies what constitutes a violation of the NAVMED P-5010-1:

a. Items are marked as violations on the inspection report when they clearly exist in the food establishment. A violation represents a deviation from a NAVMED P-5010-1 provision. Slight violations, such as one dirty utensil among thousands of clean ones, does not indicate that the establishment is significantly deviating from the requirement to use clean utensils.

b. Each violation of a NAVMED P-5010-1 provision is reported as a separate item on the inspection report. This does not mean that each instance should be considered a distinctly separate reportable violation. Some discretion is warranted when preparing the inspection report.

(1) For example, a cooler with mechanical problems may result in a dozen or more potentially hazardous food items being held at unsafe temperature. It may categorically be considered a malfunctioning refrigeration device under **Cooling, Heating, and Holding Capacities**, because repairs are needed to bring the unit into compliance. The food temperature violation is also cited only one time under, **Potentially Hazardous Food, Hot and Cold Holding**. Additionally, each food out of acceptable time/temperature range should be discarded by the food establishments manager and disposition noted on the report.

(2) Alternatively, the unit may be properly functioning, but improper cooling practices were used, resulting in the high temperatures being found in the potentially hazardous food. This would be a violation of **Cooling Methods, and Potentially Hazardous Food, Hot and Cold Holding.**

(3) If 12 separate coolers were found with items out of temperature as the result of 12 separate instances of improper practices by employees, each instance should be individually cited as a critical violation. The details included in each citation should clearly delineate the conditions found in each instance.

(4) Failure to clean floors is another example which can be easily visualized. A large meat cutting room may have numerous separate areas requiring cleaning. If there is a build-up of old food debris and other filth on the floor of the room in five separate areas, then one violation would exist. However, if the cleaning problem existed in multiple rooms, one violation is cited for each.

6-5 CLOSURE CRITERIA

If the PMA considers any one or more violations a significant danger to health, the PMA will promptly notify the commanding officer and recommend the facility immediately cease food service until the significant danger to health has been eliminated.

APPENDIX A. FOOD BORNE ILLNESSES

A-1 GENERAL INFORMATION
A-2 FOOD BORNE ILLNESSES
A-3 GUIDELINES FOR INVESTIGATING FOOD BORNE ILLNESS

A-1 GENERAL INFORMATION

a. Food is defined as a substance taken or absorbed in the body of an organism in order to sustain growth and repair, support vital processes and furnish energy for all activities of the organism. Though it is usually considered necessary for the preservation and maintenance of good health, there are several instances in which food may be harmful to an individual's health.

b. Food can affect health as a result of:

(1) Hypersensitivity or allergic conditions in which individuals will exhibit symptoms of an allergic reaction usually immediately upon ingestion of the food. The symptoms range from lip swelling, mild rash, angioedema to anaphylactic shock.

(2) Enzymes and other deficiency conditions in which the complete absence or abnormal function of an enzyme or substrate of a specific metabolic process will result in the abnormal processing of certain food. An example is lactase deficiency. In individuals who are deficient in this intestinal mucosal enzyme which catalyzes the breakdown of lactose, the ingestion of milk (which contains lactose) will result in abdominal cramping, bloating, flatulence, and diarrhea. This generally results in the abnormal accumulation of certain metabolites and deficiency of others.

(3) Contamination in which the food serves as a major vehicle for transmission of diseases in the population. Production and processing of food creates many opportunities for contamination before it reaches the consumer.

A-2 FOOD BORNE ILLNESSES

a. Food borne illnesses are syndromes acquired by the consumption of food contaminated by disease pathogens, microbial toxins, or poisonous chemical substances. These illnesses are frequently subclassified as infections or intoxications.

b. **Food Borne Infection:**

(1) A food borne infection is caused by the ingestion of food containing pathogenic microorganisms (i.e., bacteria, virus

or parasite) which must multiply within the gastrointestinal tract, producing widespread inflammation. The most commonly implicated microorganisms include species of *Salmonella, Shigella, E. coli 0157:H7,* etc. These infections have longer incubation periods than those experienced with food intoxications, usually commencing from 6-24 hours or longer after ingestion. Symptoms may include fever, headache, nausea, vomiting, diarrhea, abdominal pain or distress, and prostration. The causative organism may be identified by laboratory examination of the vomitus, feces, or blood and the suspected food, when available.

(2) Foods most commonly incriminated in outbreaks of food borne infections are meat and seafood mixtures such as hash, hamburger, creamed meat pies, crab, lobster, chicken, and turkey salads, turkey, turkey stuffing or dressing, and ham. These foods have common characteristics in they provide moisture, a good protein food supply and warmth. Given sufficient time, these factors promote an ideal environment for the growth and multiplication of microorganisms. It is important to remember these organisms do not necessarily cause any alteration in the normal appearance, odor, or taste of the food.

c. **Food Borne Intoxication:**

(1) Certain bacteria under favorable growth conditions produce chemicals (toxins) in food which when ingested will cause food intoxication. Enterotoxins produced by *Staphylococcus aureus* are heat stable (i.e., not destroyed by normal cooking temperatures) and are the cause of the most common food borne intoxication. The staphylococci multiply in the food where they produce their toxins before the food is consumed. It generally takes less than 8 hours for these organisms to elaborate enough toxins to cause symptoms. The disease is characterized by an abrupt onset (2 to 4 hours after ingestion) of symptoms of severe nausea, vomiting, diarrhea, and prostration with little or no fever.

(2) Staphylococcal food intoxication usually follows ingestion of starchy food, especially potato salad, custard and pies. When the offending food is meat, pork (including ham and salami) and poultry products are usually the source. Ham may become contaminated with staphylococci during the practice of boning, slicing and holding without adequate refrigeration for several hours before serving. In addition, highly salted ham permits staphylococcal growth but inhibits many other bacteria. Other foods commonly involved are canned or potted meat or fish, pressed tongue, beef, cheese, other milk products, cream or custard filled pastries, potato salad, and pasta salads. The usual source of the pathogens, which cause this form of food

intoxication, may be the nose, throat, boils, pimples, or infected cuts on the hands of food service personnel.

(3) Exotoxins produced by *Clostridium botulinum* cause a highly publicized but an increasingly rare disease called botulism. This disease, which causes death in about 18% of patients even with adequate treatment, is most frequently associated with home canned low acid foods (vegetables and fruits) which have been improperly processed. Ingestion of inadequately cooked toxin containing food leads to nerve toxicity manifested by symptoms of weakness, headache, and dizziness, and sometimes death due to respiratory or cardiac failure. Cases of botulism have also resulted from home canned meats and fish, smoked fish, and improperly prepared commercial products, such as vichyssoise soup and potpies.

(4) Toxins produced in food contaminated by *Bacillus cereus, Clostridium perfringens,* and *Vibrio parahaemolyticus* also cause food borne illness outbreaks.

(5) Natural poisons or intoxicants found in certain plants and animal. Some foods are poisonous at the time they are harvested. Many of the poisons in these foods tend to attack the nervous system resulting in such symptoms as weakness or paralysis, numbness, tingling of the ears, apprehension and even death. Some fish and shellfish concentrate poisons produced by toxic plankton. Certain fish (grouper, snapper, jack, and barracuda) concentrate ciguatoxin, while mollusks (clams, oysters, scallops, and mussels) concentrate the toxin associated with "red tide." Naturally poisonous plants and animals include certain mushroom species and certain tropical fish (puffer type fish and ocean sunfish).

(6) Poisons may be intentionally or incidentally introduced in foods as a result of production, processing, transportation or storing. Chemical poisonings may be caused by arsenic residue of spray on fruits or vegetables cadmium or zinc dissolved by acid foods, such as a lemonade gelatin, tomatoes etc., cadmium plated or galvanized pitchers or cans; or exposure of food and food service equipment to insecticides or other chemicals such as cleaning compounds. Chemical poisonings usually cause violent nausea, vomiting, and diarrhea very shortly after ingestion.

A-3 INVESTIGATING FOOD BORNE DISEASE OUTBREAKS

a. A food borne disease outbreak (FBDO) is defined as an incident in which two or more persons experience a similar illness resulting from the ingestion of a common food and epidemiological analysis implicates the food as the source of the illness. Food borne disease outbreaks include a single case of illness such as one person ill from botulism or chemical poisoning.

b. In the event of a suspected food borne outbreak, prompt action must be taken to identify cases associated with the outbreak, identify implicated food or beverage items, determine the factor or combination of factors which permitted the outbreak to occur and initiate measures to control or contain the spread of infection. Early identification of the causative agent allows for specific treatment of patients. Additional cases can be prevented by halting service or sale of an implicated food item. Future outbreaks can be prevented by modifying or correcting procedures for acquiring, processing and handling the implicated food. Assistance with any investigation may be obtained from the nearest occupational health/preventive medicine department at a naval hospital or clinic or NAVENPVNTMEDU by telephone or message request. *Procedures to Investigate Food borne Illness,* a publication of the International Association of Milk, Food and Environmental Sanitarians, Inc., P.O. Box 702, Ames, Iowa 50010, provides excellent guidelines for conducting an investigation.

c. Outbreak Investigation Procedures. An outbreak investigation is composed of several parts, many of which must be performed promptly and simultaneously by the person or persons conducting the investigation. Ideally, procedures, materials, personnel and responsibilities for initiating and conducting an investigation would have been developed in advance.

(1) Verify there is an epidemic or outbreak. When suspected cases of food borne illness are reported, the first step involves verifying whether an outbreak actually exists.

(2) Complete case history questionnaires.

(a) A case history questionnaire must be completed for each ill person. Figure 1-9 provides an example.

(b) A questionnaire should also be completed for any person who has not been ill, but who may have been exposed to the suspect food item, meal, or facility. These "controls" can include family members, roommates, coworkers, shipmates, and any others at risk who remained well. Comparisons of ill and well persons (e.g., food specific attack rates) are used to analyze factors contributing to the outbreak.

(c) Valid case history questionnaires collect information about: the person (name, rate or grade, social security number, residential address or work/berthing as assignments, duty station, age, race, sex, and telephone number);

their illness, if any (specific symptoms and specific times at which symptoms developed), and food history (when, where and what was eaten, as precisely as possible). The time at which food was eaten and symptoms started must be recorded precisely, e.g.,"0100" or "1245." Responsible persons should interview and complete a questionnaire for each person.

(3) Establish a diagnosis etiologically if possible, otherwise define cases clinically or epidemiologically. Obtain clinical specimens from patients, for laboratory analysis to isolate or identify the etiologic agents. Ideally, specimens should be collected during the acute phase of the illness when the patient is first seen or when the initial interview is conducted. Convalescent specimens collected after the patient recovers may be useful for comparison. If the patient has diarrhea, obtain a stool specimen or rectal swab. If the person is vomiting, collect vomitus. Blood specimens are used to detect antibodies, or isolate pathogens. Blood and/or urine specimens may also be useful in confirming diagnosis of chemical food poisoning. Contact the laboratory officer at the nearest medical treatment facility or NAVENPVNTMEDU for guidance on collecting, storing, and shipping samples for analysis. If the demand for laboratory analyses exceeds the capability of the MTF laboratory, contact the nearest NAVENPVNTMEDU. The units maintain a public health laboratory capability to conduct analysis of clinical specimens from an outbreak investigation or can assist in arranging for appropriate laboratory analysis.

(4) Collect food samples and containers. If food items are leftover from a suspect meal, or if a commercial product is suspected, collect and preserve samples for laboratory analysis. Remaining stocks of suspect food should not be used until the investigation is complete. Use aseptic techniques and containers to collect samples; seal and label each container. Collect a sample of each item weighing ½ to 1 pound or measuring ½ to 1 pint, if less is available collect all of it. Samples of perishable foods should be chilled and held below 41°F (4°C) but should not be frozen. Commercial foods in containers (e.g., jars or cans) should be kept in those containers. Empty containers of suspect commercial products should also be collected and preserved. Contact the nearest NAVENPVNTMEDU for additional guidance on collecting, storing and shipping samples for analysis. NAVENPVNTMEDU laboratories can analyze food samples or can assist in arranging for appropriate laboratory analyses.

d. Develop a case definition. A case definition allows exposed persons to be classified as either cases or noncases. A case is usually defined by symptoms, e.g., a person who was at risk and developed diarrhea (3 or more watery stools within a 24-hour period), and a timeframe. Use the data collected during the initial phase of the investigation to establish the definition. A case definition may be specific, e.g., diarrhea and fever (temperature greater than 100.5°F) or more general, (e.g., diarrhea, nausea or vomiting with or without fever). Cases can be categorized further as confirmed or suspected. A confirmed case meets the case definition and has laboratory evidence of infection (e.g., diarrhea and laboratory isolation of a pathogenic bacteria), while a suspected case meets the case definition but laboratory confirmation is lacking or incomplete (e.g., diarrhea only).

e. Make epidemiologic associations.

(1) Although the investigation is not complete, a preliminary assessment of available data helps to confirm an outbreak has or has not occurred. The investigator needs to decide if two or more persons experienced a similar illness and the cases are associated by time (e.g., onset within a few hours or days of each other), place (e.g., eating at the same establishment or event) and/or person (e.g., eating same foods).

(2) Develop a hypothesis about the type of illness, possible vehicles of transmission and means by which the vehicle was contaminated. Hypotheses are possible explanations for the outbreak; more investigation and/or more data may be necessary to prove or disprove their role in the outbreak. Table 1-10 provides information concerning incubation periods, clinical syndromes, and criteria for confirming the etiology once an FBDO has been identified. The information on incubation periods and clinical syndromes is provided as a guideline and should not be included in the confirmation criteria. These guidelines may not include all etiologic agents and diagnostic tests. Decisions on additional investigative efforts (case and control finding, laboratory analyses, etc.) and their priority should be guided by the resulting information's value in providing or disproving the current hypotheses.

f. Provide information. Keep everyone with a "need to know" informed of the progress and findings to the investigation. Who "needs to know" varies with the outbreak but may include: appropriate line commanders; the commanding officer, preventive medicine staff and/or laboratory officer of the supporting MTF; appropriate public affairs officers (PAO); and local health department representatives. If the situation requires informing the public, work with a PAO or local risk communication personnel to provide objective factual information about the outbreak and clear recommendations on actions that the public should take. File a Medical Event Report per BUMEDINST 6220.12 series.

g. Expand the investigation. Often the initial investigation will identify a pathogen. The investigator may have a plausible hypothesis for the vehicle and its method of contamination. The food service manager may have implemented the recommendations to prevent further illness. It is often tempting to conclude the investigation at this point. Such superficial investigations may underestimate the true number of cases, miss the true method of contamination, and fail to alter potentially hazardous food handling procedures. At this point it is important to find and interview additional persons (both ill and well) at risk. Complete food history questionnaires on both ill and well and obtain clinical specimens from ill persons. It may be appropriate to seek assistance, either consultative support or on-site support, from the nearest NAVENPVNTMEDU.

h. Investigate food handling procedures. The investigation must inquire into the source and method of preparation of each item of food or drink served at a suspected meal. Although a standard inspection may be conducted, an investigation focusing on high risk foods and their handling may be more productive. A flowchart documenting the individual steps from delivery, through preparation, to service of highly suspect items may be helpful. Talk with the person in charge, shift supervisors and the watch captains. Collect menus, recipes, and lists of personnel with their assignments. Separately interview food service personnel involved in handling the suspect item(s). Food service personnel should have a physical examination and specimens should be collected (e.g., stool sample or rectal swab), if appropriate.

i. Analyze the data. The organization and summary of data collected from ill and well persons who ate or drank the suspect item or meal help to classify the illness, identify involved groups, and identify a possible vehicle for transmission.

(1) Plot an epidemic curve. Prepare a graph of the distribution of cases (ill persons) by the time of onset of their symptoms (Figure 1-11.) The period of time covered by the outbreak determines the unit of time used on the graph. For staphylococcal food poisoning, use a scale of hours; for a possible salmonella outbreak, use 6 or 12-hour periods; and for hepatitis A, use days. A common source outbreak graph will show a sharp peak when many cases developed their symptoms followed by a gradual tapering off of cases. Figure 1-1 displays data for a common source outbreak of staphylococcal food poisoning. An outbreak with person to person spread (e.g., shigellosis) will show a slower rise to a less distinct peak or may have no dominant peak.

(2) Identify the common symptoms and signs. Symptoms are felt by a person, while signs are noted by an observer. Use data

from ill persons to prepare a chart showing the percentage of cases with specific symptoms (e.g., nausea or headache) and signs (e.g., fever). The predominate signs and symptoms, whether enteric, neurologic or generalized, help limit the list of possible agents that caused the outbreak.

(3) Calculate incubation periods and determine a median incubation period.

(a) The interval between ingestion of the suspect food and the appearance of an initial symptom or sign of illness is the incubation period. Knowledge of the median incubation period further limits the list of possible causative agents for the outbreak. The median is used because it is not affected by exceptionally long or short incubation periods, as is the mean (average) value.

(b) Calculate the interval for each case, and determine the range of incubation periods by identifying the shortest and longest incubation period. Calculate the median incubation period. (Make a list of the individual incubation periods from shortest to longest. The middle value on the list, or the average of the two middle values if there is an even number of cases, is the median incubation period.)

(c) Table 1-12 displays data on symptom onset and incubation period for a common source outbreak of staphylococcal food poisoning. Table 1-12 shows the incubation periods grouped by 2-hour intervals. Both the median incubation period (3.5 hours) and the large number of cases with illness onset between 2 and 4 hours after eating the suspect food are consistent with staphylococcal food poisoning.

(4) Calculate attack rates.

(a) Attack rates, the percentage of ill persons, may be food or meal specific. For either type of attack rate to be meaningful, the investigator must have food and/or meal histories on both ill and well persons who were at risk of eating the suspect food or meal.

(b) Food specific attack rates help pinpoint a suspect food within a meal, and can support observations and conclusions on food handling that contributed to the outbreak. Meal specific attack rates are appropriate when an investigation has not pinpointed a particular meal; the results may help focus further investigative efforts.

(c) To calculate the rates, divide the number of persons who become ill after they ate a particular food or meal by the total number of persons (both cases and controls) who ate that food or meal, and multiply the results by 100. Do the same for the persons who did not eat that particular food or meal. A highly suspect food or meal will have the highest attack rate for those who ate that food or meal, and the lowest attack rate for those who did not eat that food or meal. The difference between the two rates provides an easy method of comparing different meals or different foods.

(d) When investigating a disease with a long incubation period (e.g., hepatitis A), attack rates based on food preference rather than actual consumption may be necessary. A person's food preferences may be determined by asking if, when given a choice, they always or usually eat certain foods (e.g., raw oysters), purchase particular brand items, or dine at a particular restaurant.

(e) Table 1-14 is an example of a food specific attack rate analysis. Persons who reported they ate potato salad have a high rate of illness. The difference in attack rates is greatest for potato salad, which implicates this food item as the vehicle in the outbreak. Note that not all people who reported eating potato salad became ill. Variations in illness may be explained by one or more of the following conditions: recall bias (some people may not accurately remember events as they occurred), dose or inoculum (the number of organisms or amount of toxin ingested), and susceptibility. Some people may not accurately remember what they ate or did not eat.

j. Use investigative data for prevention. Preventing further illnesses is the primary purpose of a food borne illness investigation. During or immediately after completing the investigation, recommend and/or implement measures to prevent further illness.

k. Submit a Medical Event Report. Any food borne disease outbreak must be reported following the guidelines of BUMEDINST 6220.12 series on Medical Event Reports.

Figure 1-9. Case History Questionnaire

Name:	Grade/ Rate:	SSN:	Duty Station:

Work Telephone:	Home Telephone:	Age:	Sex:	Home Address:

Other Information:

Signs and Symptoms (check appropriate items)

☐ Burning Sensations (mouth) ☐ Metallic Taste ☐ Excessive Salivation ☐ Nausea ☐ Vomiting ☐ Flushing ☐ Itching ☐ Prostration ☐ Cyanosis	☐ Abdominal Cramps ☐ Diarrhea ☐ Bloody Diarrhea ☐ Mucus Diarrhea ☐ Watery Diarrhea ______ # of Bowel Movements Per Day ☐ Fever ________Temp ☐F ☐ Duration of Fever	☐ Headache ☐ Chills ☐ Myalgia ☐ Edema ☐ Jaundice ☐ Anorexia ☐ Rash ☐ Weakness ☐ Dehydration	☐ **Numbness** ☐ **Dizziness** ☐ **Double Vision** ☐ **Blurred Vision** ☐ **Dysphagia** ☐ **Dysphoria** ☐ **Delirium** ☐ **Paralysis** ☐ **Coma**

Other Symptoms:

Time and Date of Onset:	Duration:	Severity: mild - severe 1 2 3 4	Treatment:

Physician Consulted: Telephone:	Address:
Hospital: Telephone:	Address:

Specimens Obtained:	Time/Date of Collection:	Laboratory Results:

Remarks and Diagnosis:

☐ Ill ☐ Well

Rev Aug 99

Figure 1-9. Case History Questionnaire (cont.)

Food History for Previous 72 Hours or Other Specified Time					
Day of Illness					
Breakfast		Lunch		Supper	
Hour:	Place:	Hour:	Place:	Hour:	Place:
Food Items:		Food Items:		Food Items:	
Day Before Illness					
Breakfast		Lunch		Supper	
Hour:	Place:	Hour:	Place:	Hour:	Place:
Food Items:		Food Items:		Food Items:	
Two Days Before Illness					
Breakfast		Lunch		Supper	
Hour:	Place:	Hour:	Place:	Hour:	Place:
Food Items:		Food Items:		Food Items:	
Snacks (items, time and place)					
History of Eating Suspect Food					
Food:		Source:		Address:	
Common Event and Names and Addresses of others at event:					
Recent Travel (locations):					
Contacts With Known Cases Before Illness:					
Contact After Illness:					
Other Conditions (Housing Condition, Crowding, Water/Milk Supply, Excreta Disposal, Shellfish):					
Additional Remarks:					
Investigator:				Date:	

Table 1-10. Guidelines for confirmation of food borne disease outbreaks

Etiologic agent	Incubation period	Clinical syndrome	Confirmation
Bacterial			
1. *Bacillus cereus*			
a. Vomiting toxin	1-6 hrs	Vomiting, some patients with diarrhea; fever uncommon	Isolation of organism from stool of two or more ill persons and not from stool of controls OR Isolation of $\geq 10^5$ organisms/g from epidemiologically implicated food, provided specimen properly handled
b. Diarrheal toxin	6-24 hrs	Diarrhea, abdominal cramps, and vomiting in some patients; fever uncommon	Isolation of organism from stool of two or more ill persons and not from stool of controls OR Isolation of $\geq 10^5$ organisms/g from epidemiologically implicated food, provided specimen properly handled
2. *Brucella*	Several days to several mos, usually >30 days	Weakness, fever, headache, sweats, chills, arthralgia, weight loss, splenomegaly	Two or more ill persons and isolation of organism in culture of blood or bone marrow, greater than fourfold increase in standard agglutination titer (SAT) over several wks, or single SAT titer $\geq$1:160 in person who has compatible clinical symptoms and history of exposure
3. *Campylobacter*	2-10 days, usually 2-5 days	Diarrhea (often bloody), abdominal pain, fever	Isolation of organism from clinical specimens from two or more ill persons OR Isolation of organism from epidemiologically implicated food
4. *Clostridium botulinum*	2 hrs-8 days, usually 12-48 hrs	Illness of variable severity; common symptoms are diplopia, blurred vision, and bulbar weakness; paralysis, which is usually descending and bilateral, may progress rapidly	Detection of botulinal toxin in serum, stool, gastric contents, or implicated food OR Isolation of organism from stool or intestine

Etiologic agent	Incubation period	Clinical syndrome	Confirmation
Bacterial (cont'd)			
5. *Clostridium perfringens*	6-24 hrs	Diarrhea, abdominal cramps, vomiting and fever are uncommon	Isolation of $\geq 10^6$ organisms/g in stool of two or more ill persons, provided specimen properly handled OR Demonstration of enterotoxin in the stool of two or more ill persons OR Isolation of $\geq 10^5$ organisms/g from epidemiologically implicated food, provided specimen properly handled
6. *Escherichia coli*			
a. Entero-hemorrhagic (E. coli 0157:H7 and others)	1-10 days, usually 3-4 days	Diarrhea (often bloody), abdominal cramps (often severe), little or no fever	Isolation of *E. coli* 0157:H7 or other Shiga-like toxin-producing *E. coli* from clinical specimen of two or more ill persons OR Isolation of *E. coli* 0157 or other Shiga-like toxin-producing *E. coli* from epidemiologically implicated food
b. Enterotoxigenic (ETEC)	6-48 hrs	Diarrhea, abdominal cramps, nausea; vomiting and fever are less common	Isolation of organism of same serotype, which are demonstrated to produce heat stable (ST) and/or heat labile (LT) enterotoxin, from stool or two or more ill persons
c. Enteropatho-genic (EPEC)	Variable	Diarrhea, fever, abdominal cramps	Isolation of same enteropathogenic serotype from stool of two or more ill persons
d. Enteroinvasive (EIEC)	Variable	Diarrhea (may be bloody), fever, abdominal cramps	Isolation of same enteroinvasive serotype from stool of two or more ill persons
7. *Listeria monocytogenes*			
a. Invasive disease	2-6 wks	Meningitis, neonatal sepsis, fever	Isolation of organism from normally sterile site
b. Diarrheal disease	Unknown	Diarrhea, abdominal cramps, fever	Isolation of organism of same serotype from stool of two or more ill persons exposed to food that is epidemiologically implicated or from which organism of same serotype has been isolated

Etiologic agent	Incubation period	Clinical syndrome	Confirmation
Bacterial (cont'd)			
8. Nontyphoidal *Salmonella*	6 hrs-10 days, usually 6-48 hrs	Diarrhea, often with fever and abdominal cramps	Isolation of organism of same serotype from clinical specimens from two or more ill persons OR Isolation of organism from epidemiologically implicated food
9. *Salmonella typhi*	3-60 days, usually 7-14 days	Fever, anorexia, malaise, headache, and myalgia; sometimes diarrhea or constipation	Isolation of organism from clinical specimens of two or more ill persons OR Isolation of organism from epidemiologically implicated food
10. *Shigella*	12 hrs-6 days, usually 2-4 days	Diarrhea (often bloody), frequently accompanied by fever and abdominal cramps	Isolation of organism of same serotype from clinical specimens from two or more ill persons OR Isolation of organism from epidemiologically implicated food
11. *Staphylococcus aureus*	30 min-8 hrs, usually 2-4 hrs	Vomiting, diarrhea	Isolation of organism of same phage type from stool or vomits or two or more ill persons OR Detection of enterotoxin in epidemiologically implicated food OR Isolation of $\geq 10^5$ organisms/g from epidemiologically implicated food, provided specimen properly handled
12. *Streptococcus* Group A	1-4 days	Fever, pharyngitis, scarlet fever, upper respiratory infection	Isolation of organism of same M- or T-type from throats of two or more ill persons OR Isolation of organism of same M- or T-type from epidemiologically implicated food

Etiologic agent	Incubation period	Clinical syndrome	Confirmation
Bacterial (cont'd)			
13. *Vibrio cholerae*			
a. 01 or 0139	1-5 days	Watery diarrhea, often accompanied by vomiting	Isolation of toxigenic organism from stool or vomitus or two or more ill persons OR Significant rise in vibriocidal, bacterial-agglutinating, or antitoxin antibodies in acute and early convalescent phase sera among persons not recently immunized OR Isolation of toxigenic organism from epidemio-ogically implicated food
b. non-01 and non-0139	1-5 days	Watery diarrhea	Isolation of organism of same serotype from stool of two or more ill persons
14. *Vibrio parahaemolyticus*	4-30 hrs	Diarrhea	Isolation of kanagawa positive organism from stool of two or more ill persons OR Isolation of $\geq 10^5$ kanagawa positive organisms/g from epidemiologically implicated food, provided specimen properly handled
15. *Yersinia enterocolitica*	1-10 days, usually 4-6 days	Diarrhea, abdominal pain (often severe)	Isolation of organism from clinical specimen of two or more ill persons OR Isolation of pathogenic strain or organism from epidemiologically implicated food

CHAPTER 1, FOOD SAFETY

Etiologic Agent	Incubation period	Clinical syndrome	Confirmation
Chemical			
1. Marine toxins			
a. Puffer fish, tetrodotoxin	10 min-3 hrs, usually 10-45 min.	Parasthesia of lips, tongue, face, or extremities, often following numbness; loss of proprioception or "floating" sensations	Demonstration of tetrodotoxin in epidemiologically implicated fish OR Clinical syndrome among persons who have eaten puffer fish
b. Paralytic or neurotoxic shellfish poison	30 min-3 hrs	Parasthesia or lips, mouth or face, and extremities; intestinal symptoms or weakness, including respiratory difficulty	Detection of toxin in epidemiologically implicated food OR Detection of large numbers of shellfish poisoning associated species of dinoflagellates in water from which epidemiologically implicated mollusks are gathered
c. Scombroid toxin (histamine)	1 min-3 hrs, usually <1 hr	Flushing, dizziness burning of mouth and throat, headache, gastrointestinal symptoms, urticaria, and generalized pruritus	Demonstration of histamine in epidemiologically implicated food OR Clinical syndrome among persons who have eaten type of fish previously associated with histamine fish poisoning (e.g., mahi-mahi or fish of order Scomboidei)
d. Ciguatoxin	1-48 hours, usually 2-8 hrs	Usually gastrointestinal symptoms followed by neurologic symptoms (including parasthesia of lips, tongue, throat, or extremities) and reversal of hot and cold sensation	Demonstration of ciguatoxin in epidemiologically implicated fish OR Clinical syndrome among persons who have eaten a type of fish previously associated with ciguatera fish poisoning (e.g., snapper, grouper, or barracuda)

Etiologic Agent	Incubation period	Clinical syndrome	Confirmation
Chemical (cont'd)			
2. Heavy metals a. Antimony b. Cadmium c. Copper d. Iron e. Tin f. Zinc	5 min-8 hrs, usually <1 hr	Vomiting, often metallic taste	Demonstration of high concentration of metal in epidemiologically implicated food
3. Monosodium glutamate (MSG)	3 mins-2 hrs, usually <1 hr	Burning sensation in chest, neck, abdomen, or extremities; sensation of lightness and pressure over face or heavy feeling in chest	Clinical syndrome among persons who have eaten food containing MSG (i.e., usually $\geq$1.5 g MSG)
4. Mushroom toxins			
a. Shorter acting toxins:	$\leq$2 hrs	Usually vomiting and diarrhea, other symptoms differ with toxin:	Clinical syndrome among persons who have eaten mushroom identified as toxic type OR Demonstration of toxin in epidemiologically implicated mushroom or mushroom containing food
Muscimol		Confusion, visual disturbance	
Muscarine		Salivation, diaphoresis	
Psilocybin		Hallucinations	
Coprinus artrementaria		Disulfiram like reaction	
Ibotenic acid		Confusion, visual disturbance	
b. Longer acting toxin (e.g., *Amanita* spp.)	6-24 hrs	Diarrhea and abdominal cramps for 24 hrs followed by hepatic and renal failure	Clinical syndrome among persons who have eaten mushroom identified as toxic type OR Demonstration of toxin in epidemiologically implicated mushroom or mushroom containing food

Etiologic Agent	Incubation period	Clinical syndrome	Confirmation
Parasitic			
1. *Cryptosporidium parvum*	2-28 days, median: 7 days	Diarrhea, nausea, vomiting, fever	Demonstration of organism or antigen in stool or in small bowel biopsy of two or more ill persons OR Demonstration of organism in epidemiologically implicated food
2. *Cyclospora cayetanensus*	1-11 days, median: 7 days	Fatigue, protracted diarrhea, often relapsing	Demonstration of organism in stool of two or more ill persons
3. *Giardia lamblia*	3-25 days, median: 7 days	Diarrhea, gas, cramps, nausea, fatigue	Two or more ill persons and detection of antigen in stool; or demonstration of organism in stool, duodenal contents, or small bowel biopsy specimen
4. *Trichinella* spp.	1-2 days for intestinal phase; 2-4 wks for systemic phase	Fever, myalgia, periorbital edema, high eosinophil count	Two or more ill persons and positive serologic test or demonstration of larvae in muscle biopsy OR Demonstration of larvae in epidemiologically implicated meat

Etiologic Agent	Incubation period	Clinical syndrome	Confirmation
Viral			
1. Hepatitis A	15-50 days, median: 28 days	Jaundice, dark urine, fatigue, anorexia, nausea	Detection of IgM anti-hepatitis A virus in serum from two or more persons who consumed epidemiologically implicated food
2. Norwalk family of viruses, small round structured viruses (SRSV)	15-77 hrs, usually 24-48 hrs	Vomiting, cramps, diarrhea, headache	More than fourfold rise in antibody titer to Norwalk virus or Norwalk like virus in acute and convalescent sera in most serum pairs OR Visualization of small, round-structured viruses that react with patient's convalescent sera but not acute sera - by immune electron microscopy. Assays based on molecular diagnostic (e.g., polymerase chain reaction [PCR], probes, or assays for antigen and antibodies from expressed antigen) are available in reference laboratories.
3. Astrovirus, calicivirus, others	15-77 hrs, usually 24-48 hrs	Vomiting, cramps, diarrhea, headache	Visualization of small, round structured viruses that react with patient's convalescent sera but not acute sera - by immune electron microscopy. Assays based on molecular diagnostics (e.g., PCR, probes, or assays for antigen and antibodies from expressed antigen) are available in reference laboratories.

Figure 1-11. Example of an epidemic histogram of cases by time of symptom onset

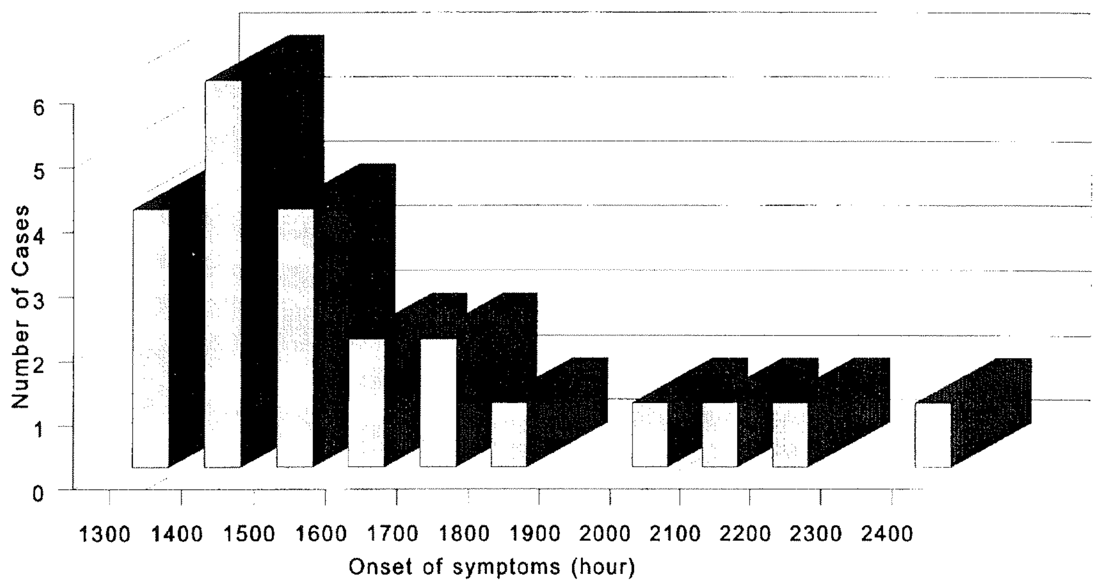


Table 1-12. Example of incubation periods, onset, and meal times by patient for a staphylococcal food poisoning outbreak

Patient (number)	Ate Meal (time)	Became Ill (time)	Incubation Period (hours)
8	1300	1345	0.75
20	1130	1300	1.50
2	1130	1330	2.00
12	1130	1345	2.25
21	1200	1415	2.25
13	1130	1415	2.75
9	1130	1430	3.00
10	1145	1445	3.00
7	1130	1430	3.00
4	1130	1445	3.25
5	1130	1500	3.50
14	1200	1530	3.50 Median
16	1130	1515	3.75
22	1230	1615	3.75
23	1200	1600	4.00
3	1130	1545	4.25
11	1230	1715	4.75
15	1200	1730	5.50
18	1300	1845	5.75
1	1200	2000	8.00
6	1300	2115	8.25
17	1130	2230	11.00
19	1130	0030	13.00
Total (23 Cases)			102.75

Incubation period:
Range: 0.75 hours (shortest)
To 13.00 hours (longest)
Median: 3.5 hours
Mean: 4.5 hours (102.75 ÷ 23)

Table 1-13. Example of incubation periods grouped by two hour intervals for a staphylococcal food poisoning outbreak

Incubation Period	Number of Cases
First 2 Hours	2
2nd-3rd Hours	12
4th-5th Hours	5
6th-7th Hours	0
8th-9th Hours	2
10th-11th Hours	1
12th-13th Hours	1

Table 1-14. Example of food specific attack rates for an outbreak investigation

Persons Exposed (ate food)					Persons Not Exposed (did not eat food)			
Food Item	**Total**	**# Ill**	**% Ill**		**Total**	**# Ill**	**% Ill**	**Difference in % Ill**
Potato salad	246	192	78.0		58	4	6.9	71.1
Tomatoes	253	127	50.2		51	19	37.3	12.9
Ice cream	201	98	48.8		103	48	46.6	2.2
Beans	258	129	50.0		46	17	37.0	13.0
Ham	230	108	47.0		74	38	51.4	-4.4
Crab Cakes	235	124	52.8		69	22	31.9	20.9

APPENDIX B. REFERENCES

The following is a list of publications referenced and used in the preparation of this chapter:

B-1 FOOD

a. NAVSUP PUB 7, Armed Forces Recipe Service

b. NAVSUP PUB 421, Food Service Operations

c. NAVSUP PUB 486, Food Service Management

d. Marine Corps Order P10110.14 series, Food Service and Subsistence Manual

e. NAVMED P-117, Manual of the Medical Department, chapter 22

f. U. S. Navy Regulations 111, Quality and Quantity of Rations

g. NAVSUPINST 4355.2 series, Inspection of Subsistence Supplies and Services

h. NAVSUPINST 4355.6 series, DoD Veterinary/Medical Laboratory Food Safety and Quality Assurance

i. NAVSUPINST 10110.8 series, DoD Hazardous Food and Non-prescription Recall System

j. FDA Food Code

k. Title 21, Code of Federal Regulations (21 CFR), Food and Drugs

l. Title 7, Code of Federal Regulations (7 CFR), Agriculture

CHAPTER 1, FOOD SAFETY

B-2 FOOD SERVICE EQUIPMENT

a. National Sanitation Foundation Standards Nos. 1, Soda Fountain and Luncheonette Equipment; 2, Food Service Equipment; 3, Commercial Spray Type Dishwashing Machines; 4, Commercial Cooking and Hot Food Storage Equipment; 5, Hot Water Generating and Heat Recovery Equipment; 6, Dispensing Freezers; 7, Food Service Refrigerators and Storage Freezers; 8 Commercial Powered Food Preparation Equipment; 12, Automatic Ice Making Equipment; 13, Refuse Compactors and Compactor Systems; 18, Manual Food and Equipment Beverage Dispensing Equipment; 20, Commercial Bulk Milk Dispensing Equipment; 21, Thermoplastic Refuse Containers; 25, Vending Machines for Food and Beverages; 26, Pot, Pan and Utensil Washers; 29, Detergent/Chemical Feeders for Commercial Spray Type Dishwashing Machines; 35, Laminated Plastics for Surfacing Food Service Equipment; 36, Dinnerware; 37, Air Curtains for Entranceways in Food Establishments; 51, Plastic Materials and Components Used in Food Equipment; 52, Supplemental Flooring; 59, Food Carts; C-2 Special Equipment and/or Devices

b. NAVSEA S9AA0-AA-SPN-010/GEN-SPEC, General Specifications for Ships of the United States Navy, Section 651, Food Service Spaces

c. NAVSHIPS 0901-LP-340-0001, Naval Ships Technical Manual, chapter 9340, Commissary Equipment

d. Department of Defense Construction Criteria Manual, 4270.1-M

B-3 WARE WASHING MACHINES

a. MIL-HDBK-740, Military Standardization Handbook Dishwashing Operations

b. NAVSHIPS 0901-LP-340-0001, Naval Ships Technical Manual, Chapter 9340, Commissary Equipment

B-4 MILK

a. MIL-STD-175, Equipment and Methods for Handling of Milk Products in Bulk Milk Dispensing Operations

b. NAVSUPINST 4355.6 series, DoD Veterinary/Medical Laboratory Food Safety and Quality Assurance

c. USPH Publication NQ 229, Grade "A" Pasteurized Milk Ordinance, U. S. Department of Health and Human Services

d. Dairy Plants Surveyed and Approved for USDA Grading Service, (Published Quarterly), USDA Agriculture Marketing Service (AMS), Dairy Division Dairy Grading Section, Washington, DC 20250

e. IMS List-Sanitation Compliance and Enforcement Ratings of Interstate Milk Shippers, (Published Quarterly), Department of Health and Human Services, Public Health Service, Food and Drug Administration, Milk Safety Branch, 200 C Street SW, Washington, DC 20204

f. Standard Methods for the Examination of Dairy Products, American Public Health Association 1010 Fifteenth Street NW, Washington, DC 20005

B-5 ICE

a. Public Health Service Publication No. 1183, A Sanitary Standard for Manufactured Ice

b. Sanitary Standards for Packaged Ice, The Sanitation Committee, Packaged Ice Association, 1100 Raleigh, NC 27601; Title 21, Code of Federal Regulations, parts 103,110, and 129

B-6 FIELD SANITATION

a. NAVMED P-010-9, Preventive Medicine for Ground Forces

b. FM 21-10/AFM 161-10, Joint Army and Air Force Publication, Field Hygiene and Sanitation

c. MIL-HDBK-740, Military Standardization Handbook Dishwashing Operations

B-7 CLUBS, MESSES, EXCHANGES, AND COMMISSARIES

a. BUPERSINST 1710.13A, Operation of Navy Messes Ashore and Package Stores

b. NAVSUP PUB 486, Volume 11 Food Service Management, Officers' Quarters and Messes and Chief Petty Officers' Messes Afloat

c. Marine Corps Order P1700.27, Marine Corps Policy Manual

d. FDA Food Code

e. NAVRES PUB-145 Vol 1-4, Navy Exchange Manual

f. MIL-STD-903, Sanitary Standards for Commissaries

B-8 FOOD BORNE ILLNESSESS

a. BUMEDINST 6220.12A, Medical Event Reports

b. Control of Communicable Diseases Manual, Sixteenth Edition, 1995; American Public Health Association

c. Procedures to Investigate Food Borne Illness, Fourth Edition, International Association of Milk, Food and Environmental Sanitarians, Inc.

B-9 PEST CONTROL

a. NAVMED P-5010, Chapter 8, Navy Entomology and Pest Control

b. OPNAVINST 6250.4A, Pest Management Programs

c. BUMEDINST 6250.14, Procurement of Deratting/Deratting Exemption Certificates

d. NAVSUP PUB-486, VOL I, Food Service Management

e. Navy Shipboard Pest Control Manual

f. Military Standard 904A (MIL-STD-904A), Evaluation and Prevention of Pest Infestation in Subsistence

APPENDIX C. MODEL FORMS

C-1 INTRODUCTION

This section provides the forms necessary to carry out sanitation inspections, medical screening, and temporary food establishment permitting procedures prescribed in this chapter. A model HACCP Inspection Data form has also been included. All forms are intended to be reproduced locally.

C-2 FOOD ESTABLISHMENT INSPECTION REPORT

C-3 FOOD ESTABLISHMENT INSPECTION GUIDE

C-4 MEDICAL SCREENING FORM

C-5 REQUEST FORM FOR PERMIT TO OPERATE A TEMPORARY FOOD ESTABLISHMENT

C-6 HAACP INSPECTION DATA FORM

FOOD ESTABLISHMENT INSPECTION REPORT

Violations cited in this report shall be corrected within the time frames specified below, but within a period not to exceed 10 calendar days for critical items or 90 days for noncritical items.

FOOD ESTABLISHEMENT RISK CATEGORY TYPES (Check one)
WITH MAXIMUM NUMBER OF CRITICAL VIOLATIONS

☐ Type 1	☐ Type 2	☐ Type 3	☐ Type 4
Max. Critical: 2	Max. Critical: 4	Max. Critical: 7	Max. Critical: 7

TOTAL VIOLATIONS: CRITICAL _____ NONCRITICAL_____

ESTABLISHMENT:		DATE:	TIME:
ADDRESS:	CITY:	STATE:	ZIP:
PERSON IN CHARGE / TITLE:		TELEPHONE:	
INSPECTOR / TITLE:			
INSPECTION TYPE: ☐ ROUTINE ☐ FOLLOW-UP ☐ COMPLAINT ☐ OTHER:			

Critical (X)	Repeat (X)	Code Reference	Violation Description / Remarks / Corrections

NAVMED 6240/1 (Rev. 12/97)

Food Establishment Inspection Report Page __ of ___

FOOD ESTABLISHMENT INSPECTION REPORT
(Continuation)

ESTABLISHMENT		DATE:	TIME:
		Code Reference	Violation Description / Remarks / Corrections

NAVMED 6240/1 (Rev. 12/97)

Food Establishment Inspection Report Page __ of ____

CHAPTER 1, FOOD SAFETY

FOOD SERVICE INSPECTION GUIDE
List of Frequent Discrepancies
(Critical Items marked with *)

MANAGEMENT AND PERSONNEL

2-1.1	Person in Charge designated/on premises.*
2-1.2.1.A	Person in Charge able to demonstrate knowledge.*
2-1.2.2	Food service personnel training current and documented in training records.*
2-2.5.1	Food service personnel physicals current.*
2-2.5.2	Personnel performing food preparation free of communicable disease.*
2-3.1	Hands washed, good hygienic practices (observed).*
2-4.1.1	Proper hygienic practices, eating/drinking/smoking prohibited (evidence).*
5-7.2(B)	Hand washing facilities provided with adequate soap, hot/cold running water, hand drying single use towels/dryer*
2-3.4, 2-4.2	Clean clothes, hair restraints.
2-3.1.4(B)	Hand washing signs posted.
2-3.5	Clothing and other personal items absent from food service areas.

FOOD AND MILK SOURCES

3-1.2.1(B)(1)	Procured from an approved source.*
3-1.2.1(B)(3)	Wholesome and in sound condition.*

TEMPERATURE CONTROL OF POTENTIALLY HAZARDOUS FOODS

3-4.2	Cold food at proper temperatures during storage, display, service, transport, and cold holding.*
3-4.3	Hot foods at proper temperatures.*
3-5.2, 3-5.6	Foods properly cooked and/or reheated.*
3-5.6	Foods properly cooled.*
3-4.2.A(3)	Refrigeration Units maintain proper temperatures.*
3-4.6	Protected from decayed foods, contamination, and spoilage.*
3-5.7, 3-4.2	Frozen foods stored properly 0°F. or below, correctly thawed and not refrozen.*
3-4.2(A)	Thermometers provided and conspicuously placed.

FOOD PROTECTION

3-2	Gross contamination, equipment, personnel, storage*
3-2	Potential for cross contamination; storage practices; damaged foods segregated.*
3-5.6.2	Leftover foods correctly dated, stored, and served; no unauthorized, or frozen leftovers present.*
	Advanced Prepared potentially hazardous foods which are not served immediately:
3-5.3	Held at or above 140°F.*
3-5.3, 3-5.6	Kept at or below 41°F.*
3-5.3, 3-5.6	Not held more than 4 hours between 41°F and 140°F.*
3-5.6(E)	Labeled with date and time of preparation.*
3-5.6, 3-4	Food and corresponding temperatures within standards.*
3-2	Food protection during storage, preparation, display, service, transportation adequate.
3-2.1	Foods handled with minimum manual contact.
3-5.11(E), 4-7.9,3-5.12	In use food dispensing utensils properly stored.

FOOD EQUIPMENT AND UTENSILS

4-4.4	Food contact surfaces properly cleaned and sanitized.*
4-4.4	Ware washing sanitizing temperature ____ °F.*
4-4.1	Ware washing sanitizing concentration ____ ppm.*
4-1	Food and nonfood contact surfaces designed, constructed, maintained, installed and located.
3-4.2(A)	Accurate easily readable thermometers conspicuously located in all refrigerated spaces.
3-4.1(H)	Only food items stored in food storage spaces.
4-1	Food service equipment and utensils meet standards and are properly installed.

FOOD EQUIPMENT AND UTENSILS (Continued)

4-2.1	Equipment and utensils properly air dried, handled and stored after being washed.
4-7, 5-5.4	No unauthorized supplies present or in use such as dishcloths, dish mops, soap, or steel wool.
3-4.2, 4-1	Refrigerated storage spaces are properly constructed, installed, and cleaned.
3-4.2	Refrigerated storage spaces free of excess frost/ice accumulation.
3-4.2	Refrigerated storage spaces maintained within proper temperature range.
4-7	Food service equipment and utensils properly maintained, serviced, cleansed, and sanitized.
4-2.19.1	Manual ware washing accomplished in three compartment sinks, equipped with sanitizing capability.
4-2	Automatic ware washing machines meet NSF standards or equivalent, properly cleaned, maintained, and operated with approved ware washing and sanitizing agents.

FACILITY STRUCTURE AND HOUSEKEEPING

5-10.1	Toxic items properly stored.*
5-10.2	Toxic items labeled and used properly.*
5-3.2	Rooms and equipment vented as required.
5-5.4	Cleaning gear/supplies properly stored.
5-2, 5-5	Floors, walls, ceilings, and attached equipment properly constructed, cleaned, drained, covered.
5-3.1	Lighting provided as required, fixtures shielded

SEWAGE AND PLUMBING

5-6.1	Water source safe, hot and cold under pressure.*
5-6.3, 5-6.4	Sewage and wastewater disposed properly; cross connections, back siphonage, backflow prevented.*
5-7.1, 5-7.2	Toilet, hand washing sinks, and locker rooms located and equipped properly.*
5-6.4	Adequate air gaps provided on required equipment.
5-6.1	Plumbing installed and maintained.

GARBAGE AND SOLID WASTE DISPOSAL

5-8.1	Containers covered, adequate number, insect and rodent proof, emptied at proper intervals, clean.
5-8.2	Outside storage area clean, enclosure properly constructed.

INSECT AND RODENT CONTROL

2-4.3, 5-9.2	Presence of insects/rodents; animals prohibited.*
5-9.2	Outer openings protected from insects, rodent proof.*
5-9.3	Pest control programs being carried out by certified pest control personnel.*

SAFETY

6-5	Facility free of recognized hazards that are causing or likely to cause death, or serious harm to employees and/or patrons.*

MAINTENANCE OF SPACES AND/OR GROUNDS

2-3.5, 5-5	Premises maintained free of litter/unnecessary articles

HEALTH RECORD	MEDICAL SCREENING FORM		
DATE	SYMPTOMS, DIAGNOSIS, TREATMENT, TREATING ORGANIZATION (*Sign each entry*)		
	HEALTH CARD PHYSICAL EXAMINATION (MEDICAL SCREENING)		
	TODAY:		
	1. Are you suffering from any of the following:		
	a) Diarrhea?	YES	NO
	b) Fever?	YES	NO
	c) Vomiting?	YES	NO
	d) Jaundice?	YES	NO
	e) Sore throat with fever?	YES	NO
	2. Lesions containing pus on the hand, wrist or an exposed body part?		
	(*such as boils and infected wounds, however small*)		
	PAST:		
	1. Have you ever been diagnosed as being ill with typhoid fever (*Salmonella typhi*), shigellosis (*Shigella spp.*),		
	Escherichia coli 0157:H7 infection (*E. coli* 0157:H7), or hepatitis A (hepatitis A virus)?	YES	NO
	If you have, what was the date of the diagnosis?		
	HIGH RISK CONDITIONS:		
	1. Have you been exposed to or suspected of causing a confirmed outbreak of typhoid fever, shigellosis,		
	E. coli 0157:H7 infection, or hepatitis A?	YES	NO
	2. Do you live in the same household as a person diagnosed with typhoid fever, shigellosis, hepatitis A, or		
	illness due to *E. coli* 0157:H7?	YES	NO
	3. Do you have a household member attending or working in a setting where there is a confirmed		
	outbreak of typhoid fever, shigellosis, *E. coli* 0157:H7 infection, or hepatitis A?	YES	NO
	4. Have you traveled outside the United States within the last 50 days?	YES	NO
	EXAM COMMENTS:	**☐ Qualified**	**☐ Not Qualified**
	Patient Signature	Health Care Provider Signature	

PATIENT'S IDENTIFICATION (USE THIS SPACE FOR MECHANICAL IMPRINT)

RECORDS MAINTAINED AT			
PATIENT'S NAME (*Last, First, Middle initial*)			SEX
RELATIONSHIP TO SPONSOR		STATUS	RANK/ GRADE
SPONSOR'S NAME		ORGANIZATION	
DEPART/SERVICE	SSN/IDENTIFICATION NO.		DATE OF BIRTH

CHRONOLOGICAL RECORD OF MEDICAL CARE AUTOMATED STANDARD FORM 600 (Rev: 12/97)

Food Facility
Special Event Application

To Obtain a Permit to Operate a Food Concession or, Operate a Temporary Food Establishment

Complete this application and submit to the Preventive Medicine Authority at least 30 days prior to the start of the event.

1. Event: ____________________
2. Location: ____________________
3. Dates: (include set up) event: __________ set up __________
4. Name(s) of Sponsoring Organization and Telephone numbers.

____

____

5. POC Name: ____________________ Telephone # ____________________

____________________ ____________________

6. List all foods to be served: include where food will be prepared, who will prepare the items:

Food	Prepared by/where temperature holding method/equipment

(potentially hazardous food must be kept hot, 140□F or cold, below 41□F.)

7. If potentially hazardous food is transported to the event, what is the length of time in transport? ____________________ How will the food be transported? ____________________ How will the food be kept hot or cold? ____________________

____

8. Food Source. ____________________

____

9. Hand washing facilities, including location in relation to food service and preparation: ____________________

____

Section below to be completed by the PMA

□ Approved □ Disapproved Signature: ____________________ Date: ______

Reason for Disapproval: ____________________

____

Special restrictions or requirements: ____________________

____

HAACP INSPECTION DATA FORM

EST. NAME: INSPECTOR:
DATE: TIME IN: :AM/PM TIME OUT: :AM/PM

Record all observations below - transfer violations to Inspection Report

FOOD TEMPERATURES/TIMES/OTHER CRITICAL LIMITS
Use Additional Forms If Necessary

FOOD STEP	1.	CRITICAL LIMIT	2.	CRITICAL LIMIT	3.	CRITICAL LIMIT	4.	CRITICAL LIMIT
A. SOURCE								
B. STORAGE								
C. PREP BEFORE COOK								
D. COOK								
E. PREP AFTER COOK								
F. HOT/COLD HOLD								
G. DISPLAY/ SERVICE								
H. COOL								
I. REHEAT								

OTHER FOOD TEMPERATURES OBSERVED Use steps from above for location

FOOD	**TEMP □C/□F**	**STEP**	**FOOD**	**TEMP □C/□F**	**STEP**	**FOOD**	**TEMP □C/□F**	**STEP**

MANAGEMENT/PERSONNEL OBSERVATIONS	
OTHER FOOD OBSERVATIONS	
EQUIPMENT, UTENSILS, AND LINEN OBSERVATIONS	
WATER, PLUMBING, AND WASTE OBSERVATIONS	
PHYSICAL FACILITIES	
POISONOUS OR TOXIC MATERIALS OBSERVATIONS	

HACCP Inspection Data Page 2 of 2

Bureau of
Medicine and Surgery
Washington, D.C. 20372-5300

NAVMED P-501O-2 (Rev. 1995)
0510-LP-753-5800

Manual of Naval Preventive Medicine

Chapter 2

SANITATION OF LIVING SPACES AND RELATED SERVICE FACILITIES

TABLE OF CONTENTS

Section VI. Campgrounds and Picnic Areas

Section VII. Gymnasiums

Section VIII. Theaters

Section IX. Riding Stables

Section X. Sanitation of Administrative Spaces

Section XI. Saunas and Steamrooms

Section XII. References

Illustrations

Chapter 2

SANITATION OF LIVING SPACES AND RELATED SERVICE FACILITIES

Section 1. Sanitation of Living Spaces

2-1. Scope.

1. Whenever people live or work in a close proximity, the possibility of adverse health conditions, e.g., respiratory disease transmission, is magnified. In addition, human comfort during rest or recreation has a direct bearing on morale.

2. Design plays an important role in eliminating potentially adverse health conditions in existing facilities. Cleanliness contributes to morale and is aesthetically desirable.

2-2. **Habitability.**

1. A habitable and healthful environment must prevail in living and berthing spaces ashore and afloat to maintain the efficiency of Navy and Marine Corps Personnel. To this end, construction plans for both ships and shore stations are under constant review to ensure that the latest developments in human factors engineering are incorporated into facility/ship design.

2. Major factors which pertain to living, recreation, and berthing ashore and afloat include: floor area, ventilation, heating, sanitary fixtures, water supply, lighting and color.

3. Current manuals and publications must be consulted for specific data on the above requirements and allowances. However, it must be realized that due to demands for combat effectiveness, minimum standards for sanitary facilities are not always attainable. In these circumstances, commanding officers must strive to achieve, within practicable limits, the minimum standards necessary to optimize sanitation.

2-3. Construction Standards.

1. The Department of Defense Construction Manual, DoD 4270.lM, contains technical criteria and policy guidance for design and construction of berthing facilities ashore. Detailed design criteria procedures must be consistent with guidance provided in this document. Renovation of existing structures must be undertaken in conjunction with the medical department to ensure that health and sanitation standards are incorporated at the earliest design phase of the project.

2. Berthing compartment construction or modification aboard ship must be consistent with the standards established in General *Specifications for Ships of the U.S. Navy (GenSpec).*

2-4. Berthing Aboard Ships and Barges.

1. The executive officer, medical officer or medical department representative, the OOD, JOOD, chief master at arms, division officer, and division chief petty officers must make

routine inspections of the sanitary condition of toilets, lavatories, and berthing spaces.

2. Berthing spaces must be clean at all times, well ventilated, and well illuminated. Head-to-foot sleeping arrangements for occupants of adjacent beds are recommended to reduce the potential of airborne disease transmission unless privacy curtains are installed at each bunk.

3. Except for instances of operational necessity, hot bunking is prohibited. The use of polyurethane pillows aboard ship is prohibited. Minimum requirements for pillows aboard ships are outlined in *Federal Specification V-P-356D.* Mattresses must conform to Military Specification MIL-M-18351. Mattress foam inserts must be ‘low smoke” foam rubber per Military Specification MIL-R-20092.

4. A sufficient supply of clean bed linen must be maintained. Bedding must be changed frequently to prevent odor accumulation.

5. Water closets, urinals, lavatories, and showers, must be clean and operable. Shower curtains, mats, bulkheads, and decks must be cleaned and sanitized at sufficient intervals to prevent mildew, odor, and soap accumulations. Sewage backflow through deck drains and overflowing water closets constitute extremely unsanitary conditions. If these conditions occur, the space or unit must be immediately secured until the situation is corrected and the spaces are cleaned and sanitized.

2-5. Bachelor Quarters

1. Department heads, division officers, and division leading petty officers must make routine inspections of enlisted berthing spaces in order to maintain Navy standards of sanitation. It is mandatory that the building petty officer (BPO) accompany all inspecting parties in their area of responsibility and be familiar with standard room entry procedures outlined in OPNAVINST 11103.1A.

2. With the exception of guide dogs for the blind and military working dogs, no dogs, cats or similar pets are allowed in berthing areas. Permission to maintain other animals as pets, such as fish, is the option of the commanding officer.

3. Berthing areas that are not air conditioned must have screened windows and self closing doors. All spaces must be well ventilated, illuminated, and heated to meet local weather conditions.

4. All head facilities and common areas must be cleaned daily.

5. Hot water must be delivered to the user at temperatures not to exceed 110° F in buildings with laundry and shower facilities. Hot water must be delivered at a temperature not to exceed 100” F in buildings without laundry or showers, e.g., duty rooms.

6. Complaints of unsanitary conditions existing in unaccompanied personnel housing must be investigated and promptly resolved by the BQ management.

7. Living space standards for each grade are found in the current NAVPERS 15606, Navy Bachelor Quarters Manual. The information is reproduced in Table 2-1.

2-6. Temporary Lodging Facilities.

1. Temporary lodging facilities are those that are intended for use for short periods of time, such as awaiting permanent housing, transfer, and at recreational areas where housing, such as cabins are available.

2. With the exception of guide dogs for the blind and military working dogs, dogs, cats, birds, or similar pets are prohibited in spaces intended for human occupancy. Permission to allow other types of pets is the option of the commanding officer.

3. Temporary lodging facilities must be cleaned thoroughly after each occupancy. Dishes, pots and pans, blankets and bedding must be inspected for cleanliness prior to occupancy. Periodic inspections of these facilities must be made by medical department personnel in conjunction with the facility

Table 2-1. Bachelor Quarters Standards
of Adequacy for Reporting Purposes

Grade	Transient Personnel	Permanent Party. Personnel and PCS Students
Civilians	250 square feet net living area; private room; bath shared with not *more* than one other.	See NAVPERS 15606, Navy Bachelor Quarters Manual for equivalent grades.
03 — 010		400 square feet net living area, living room, bed-room, and private bath; access to kitchen or officers' dining facility receiving appropriated fund support
01 — 02, W1 — W4		250 square feet net living area; sleeping/living room private bath.
E7 — E9	250 square feet net living area; private room; bath shared with not more than one other	270 square feet net living area, private room and bath
E5 — E6	135 square feet net living area; no more than two to a room; bath shared with not more' than one other	
El — E4 (other than recruits/"A" School)	90 square feet net living area; room configured or open bay space; not more than four to a room except in open bay; central bath.	90 square feet net living area; not more than four to a room; central bath.
E 1 — E4 "A" School	72 square feet net living area; semi-open bay; central bath.	
E 1 Recruits	72 Square feet net living area; open bay; central bath.	

1. Rooms will be measured per the guidance in Appendix D of NAVPERS 15606, Navy Bachelor Quarters Manual.
2. For BQs not described in 1 above, request assistance from your major claimant and your public works officer.

manager. These inspections may only be conducted while individual units are vacant, unless conditions warrant otherwise. Cleaning gear must be readily available for use by patrons on a day-to-day basis. Facilities for pets should be made available adjacent to the lodging facility. When such facilities are available, it is each pet owner's responsibility to ensure that their animal does not become a sanitary nuisance.

2-7. Berthing for Watch Standers.

1. Most commands have responsibilities which require individuals to remain overnight, such as: fire fighters, communications personnel, and other watch standers. The minimum requirements for the watch room are as follows:

a. Each person must be furnished with two clean sheets and a pillow case. In no case will a person be required to use the same linen that has been used by another person (hot bunking).

b. Common use mattresses and pillows must be protected from staining by body discharges by the use of mattress and pillow covers.

c. The entire areas, including the heads, must be cleaned daily. Beds, nightstands, and other common use equipment should be cleaned on a weekly basis.

d. Supervisory personnel are tasked with ensuring that optimum sanitary standards are maintained at all times.

2-8. Civilian Contract Berthing.

1. Whenever contracts are let for berthing of military personnel in a non-military facility; e.g., civilian shipyards, such housing must meet the sanitary standards for unaccompanied personnel housing as set forth in this chapter. In no case will this housing be approved until a medical officer and supply officer, or their appointed representatives inspect such housing and furnish their findings to the commanding officer. It is recommended that preventive medicine personnel accompany command representatives during the course of their inspections.

2. Contract berthing inspections must include, but not be limited to, an evaluation of the facility location in relation to an industrial area and messing facilities. Administrative consideration should be given to means of transportation to and from the work site, recreational facilities, laundry, and other personnel support facilities. If the contract berthing facility is located near the industrial site, noise levels must be determined, and walking routes evaluated to ensure there is adequate lighting and that no safety hazards exist to impede pedestrian traffic or cause injury.

3. The initial inspection should be conducted during normal working hours and once again at night to identify any unique conditions which may exist.

2-9. Preventive Medicine Inspections.

1. Medical Department personnel with preventive medicine responsibilities must conduct inspections at least quarterly.

2. It is recommended that whenever possible medical department personnel conduct their inspections in conjunction with command inspections.

3. Inspection reports which identify discrepancies and offer recommendations for corrective action must be provided to responsible personnel.

2-10. Confinement Facilities/Ashore and Afloat.

1. Afloat

a. Medical department personnel must report any unsanitary or unhealthy conditions, observed during daily sick call, to the commanding officer (per OPNAVINST 1640.9.

b. The ship's brig, if present, must be

included with the quarterly habitability inspection of living spaces.

c. Cell dimensions and sanitary facilities must conform to standards promulgated by Naval Sea Systems Command. Ventilation, heating, and illumination standards must conform to those of the crew's living spaces. For detailed information concerning shipboard detention facilities, refer to the General Specifications for Ships of the U.S. Navy and OPNAVINST 1640.8 series, Manual for the Administration of Afloat Brigs.

2. Ashore

a. SECNAVINST 1640.9A requires a daily sanitation inspection by the brig staff and a weekly inspection by a medical department representative to ensure that cleaning and maintenance procedures are being carried out. A copy of the weekly inspection must be retained in the brig records.

b. A quarterly sanitation/habitability inspection of brigs ashore must also be conducted by preventive medicine personnel.

c. Sanitary standards must conform to those standards outlined in SECNAVINST 1640.9 series, Department of the Navy Corrections Manual, DoD Construction Criteria Manual, and other Department of Defense instructions.

Section II. BARBER AND BEAUTY SHOP SANITATION

2-11. General.

Barbershops and beauty shops are operated within the jurisdiction of the Navy and Marine Corps for convenience and to enable personnel to maintain a neat appearance at minimum expense. Although these shops are seldom incriminated in the spread of disease, the potential exists if they are not operated in a sanitary manner. The following information constitutes minimum requirements for promulgating barbershop and beauty shop regulations.

2-12. Employees

1. Employees of barbershops and beauty shops must adhere to the following physical and personal hygiene requirements.

a. All barber and beauty shop employees, including personnel employed by a civilian contract, must be medically screened and determined to be free of communicable disease prior to their initial assignment. Unless required by local medical departments for specific reasons, such as indigenous labor, subsequent health screening, e.g., annual evaluation is not routinely required. The local medical officer may delegate this responsibility to non-physician civilian or military personnel, e.g., environmental health officers, physician assistants, preventive medicine technicians, independent duty corpsmen, civilian nurses, and civilian environmental health technicians. The medical screening must be sufficiently comprehensive to detect acute or chronic diseases that may be transmitted by direct or indirect contact during the performance of their services. Depending upon the prevalence of communicable diseases in the geographical location, local medical officers may order specific testing they consider necessary. Barber and beauty shop employees may be screened by local military medical departments or they may present documentary evidence, acceptable to the local medical authority, that a complete and thorough medical screening has been accomplished.

b. Barbershop and beauty shop employees must maintain good personal hygiene when attending patrons. Hands must be thoroughly washed with soap and warm water:

(1) between patrons.

(2) after touching inanimate objects that are likely to be contaminated.

(3) before leaving the shop.

c. Special care should be taken to avoid injuring the hands. Chapped, inflamed, or cut skin can allow bacteria and viruses to enter the bloodstream.

d. Wardrobe. A clean smock or other freshly laundered over garment must be worn while attending patrons.

2-13. Sanitation Requirements.

1. Barbershops/beauty shops are not to be located in food service or berthing areas. Barbershops/beauty shops may be located within BOQS and BEQs and officer and enlisted clubs; a separate room is required.

2. An adequate supply of hot and cold running water, with proper lavatory futures and waste disposal must be provided.

3. The interior of barber/beauty shops must be adequately lighted and ventilated.

4. Shops must be maintained in a clean condition.

2-14. Construction Standards for Barbershops and Beauty Shops Ashore and Afloat.

1. The Department of Defense Construction Criteria Manual, DoD Instruction 4270. l-M, outlines the space allowance and construction standards for barbershops and beauty shops ashore.

2. Afloat, the determination as to number and type of barber facilities, including female requirements, is outlined in OPNAVINST 9640.1 series, Shipboard Habitability Program.

2-15. Sanitary Practices.

1. Only Food and Drug Administration (FDA) approved tonics, lotions, bleaches, dyes, etc., are permitted in barbershops beauty shops. Only Environmental Protection Agency (EPA) registered disinfectants or sanitizing agents are acceptable in Navy and Marine Corps Facilities. Questionable or unlabeled products must be referred to the medical department for determination of suitability.

2. Therapeutic practices, such as treating pimples, ingrown hair, etc., are prohibited.

3. The treatment of eye conditions is prohibited.

4. The headrest of barber chairs must be covered with a clean towel or a clean sheet of paper for each patron.

5. Common brushes, dusters, etc., are prohibited.

6. Because of the theoretical possibility for the transmission of bloodborne pathogens, e.g., Hepatitis B Virus (HBV) and Human Immunodeficiency Virus (HIV), the practice of shaving is no longer permitted in Navy and Marine Corps barbershops and beauty shops. Therefore, the use of razors or disposable razors is prohibited.

7. Individual sanitary neck strips must be used for each patron.

8. Covering cloths must be changed daily or as often as necessary to ensure cleanliness.

9. Operator's street clothing must be stored separately from that of patrons.

10. Barbershops or beauty shop employees are not permitted to eat, drink, or smoke while attending patrons.

11. Clean, covered sanitary receptacles must be provided for waste materials and used linen. Receptacles should be lined with disposable bags.

12. The removal of cut hair from decks must be done frequently by dustless methods. Floors must be washed with detergent and water at frequent intervals to prevent the accumulation of dirt.

13. When compressed air is used to remove hair from patrons, the pressure must be 15 pounds per square inch or less.

2-16. Cleaning and Disinfection of Instruments.

1. All instruments, metallic and non-metallic, in contact with patrons must be cleaned and disinfected between each patron. Cuticle nippers, nail clippers, combs, brushes, clipper heads and all other instruments must be thoroughly washed with soap or detergent and hot water to remove all film, oil, and debris after use on each patron. Following cleaning, the instruments must then be placed in an EPA-registered disinfecting solution. Due to the patron load at some facilities, the solutions may require changing on a daily basis, while other facilities may not require this frequency. The label and Material Safety Data Sheet (MSDS) must be consulted for directions and information concerning handling and use precautions. Unless otherwise indicated by the label, all disinfecting solutions must be changed at least weekly. The medical department representative (preventive medicine service) will determine the frequency for changing solutions. All instruments disinfected in a chemical solution must be thoroughly rinsed in running potable water to remove the chemical prior to use.

2. Non-removable clipper heads must be wiped or dusted and sprayed with an EPA-registered disinfecting spray between each patron. The spray must be used with caution. Precautions include minimum use of material (consistent with proper disinfection), directing the spray away from the breathing zone of the user and any patrons in the vicinity of the procedure, minimizing skin contact, and adequate hand washing after use. Material Safety Data Sheets (MSDS) for the spray being used and container labels must also be consulted for information concerning handling and use precautions. Removable clipper heads may be disinfected with the spray or the heads may be removed and placed in a disinfecting solution as prescribed for other instruments in Paragraph 1, above.

3. Formaldehyde cabinets and ultraviolet light are not acceptable methods of disinfection in Navy and Marine Corps barbershops and beauty shops.

4. Quantity of Instruments. Adequate numbers of instruments and supplies must be available to accomplish disinfection. The following number of instruments per operator are recommended for an average shop.

a. Clipper heads (blades). Three sets of three, each set containing one size each of 000, 1, and 1-1/2.

b. Seven combs of various design.

c. Three pairs of scissors.

d. Two pairs of thinning shears.

e. Two flattop brushes.

f. Three hundred hair rollers with clips.

g. Fifteen styling brushes.

2-17. Abnormal Skin Conditions.

Serving patrons with inflamed or infectious conditions of the scalp, face, or neck without the written consent of the medical officer is prohibited.

2-18. **Regulations/Inspections.**

1. Each-barbershop or beauty shop must post a copy of these sanitary regulations in a conspicuous place. Operators are expected to read, understand, and comply with these requirements. In overseas locations, translation of the sanitation regulations into the host-nation language should be accomplished.

2. Inspection of barbershops and beauty shops must be conducted at least quarterly by medical department personnel.

Section III. Trailer Home/Recreation Vehicle (RV) Camp Grounds and Mobile Home Court Sanitation

2-19. General.

The health of trailer home/recreation vehicle and mobile home occupants, as well as residents of adjoining communities, is endangered if the facilities are not operated and maintained in a sanitary manner. The medical officer (or designated representative), must keep the commanding officer informed as to the status of sanitation. This section serves as minimum sanitary requirements for the operation of trailer/recreational vehicle camp grounds and mobile home courts. Significant variation is often encountered in local ordinances in the areas of space limitations, site selection, water supply, and sewage disposal. State and local regulations must always be consulted to ensure compliance. Safety professionals should be consulted on a regular and as needed basis to help determine adequacy of foundation systems, fuel supply, electrical, and life and fire safety considerations.

2-20. Definitions.

1. Mobile Home. A permanent dwelling. It has kitchen facilities, flush toilets, and a bath or shower.

2. Recreation Vehicle. A self-propelled and self-contained dwelling intended for temporary occupancy.

3. Trailer Home. A vehicle drawn by an automobile or truck; intended for temporary occupancy. It may or may not be equipped with toilet and bath facilities.

4. Recreational Vehicle/Trailer Home Campground. Sights for overnight or short-term parking. It has facilities available for sanitary drop, potable water, and service buildings with bath and laundry facilities.

5. Mobile Home Court. An area of ground upon which two or more mobile homes, occupied for dwelling are located.

6. Mobile Home Space. A plot of ground within a mobile home court designed to accommodate one mobile home.

7. Service Building(s). A building housing toilet and bathing facilities for males and females with laundry or other services that may be required.

2-21. Site Selection and Considerations.

1. Courts or campgrounds must not be located adjacent to swamps, marshes, heavy industrial zones, or other areas where objectionable odors, noise, or other adverse conditions would expose individuals to health hazards. The area must have good natural drainage or a storm drainage system. The drainage must not endanger any water supply. Wherever possible, the mobile home court or campground should be connected to public water and sewerage systems.

2. The area of the mobile home park or campground must be sufficient to accommodate the number of mobile home or recreational vehicle spaces for which the court was intended. It must have adequate parking spaces for motor vehicles and access roads and walkways. Service and recreation areas must be free of traffic hazards, easily accessible to all park residents, and meet the population requirements the park or campground is designed to accommodate.

2-22. Space Limitations.

1. Mobile Home Court. Space limitations are primarily governed by local regulation. These local regulations must be consulted before proceeding in the planning or construction of a mobile home park. In general, each independent mobile home space must contain a minimum of 2800 square feet and be at least 40 feet wide. A minimum of 4500 square feet must be available for double wide units. Every mobile home space must abut a driveway or other clear area with unobstructed access to the public street. Mobile homes must be parked in spaces so that there will be a minimum of 15 feet between mobile homes (side to side, end to end, or end to side) and so that no mobile home is less than 10 feet from the exterior boundary of the mobile home park.

2. Recreational Vehicle Campgrounds. Local regulations must be considered. In general, a recreational vehicle site must contain a minimum of 1000 square feet, not including roads and streets. All recreational vehicles must be located at least 25 feet from any park boundary line abutting a public street or highway, and at least 15 feet from any other property lines.

2-23. Recreation Areas.

Recreation areas and facilities must be provided to the extent that they are considered necessary to meet the population of the park. Because of the various age groups represented, two or more separate recreation areas are recommended for larger mobile home courts. Recreation areas must be located in easily accessible areas that are free of traffic hazards.

2-24. Service Buildings.

1. A trailer home or RV campground must provide one or more service buildings. Service buildings must be of substantial construction and equipped with flush type fixtures. One service building for every 20

units is recommended for parks or campgrounds intended for trailer homes or recreational vehicles. One service building for every 100 units is recommended in mobile home courts for use as an emergency sanitary facility. These buildings must contain no less than two toilets for females, one toilet and one urinal for males, one laundry tray, two lavatories and a shower with hot and cold running water for each sex. Showers may be located in several service buildings, or one centrally located shower building. When toilet facilities for males and females are located in the same building, they must be completely separated by a partition. In any case, service buildings must be located within 500 feet of the sites served.

2. Laundry facilities and adequate drying space must be provided for every 20 trailers.

3. Standards for service buildings:

a. Permanent construction provided with adequate light, heat, and ventilation.

b. Interior of moisture-resistant material to permit frequent washing and cleaning; floor impervious to water, easily cleanable, and sloped to floor drains connected to the sewage system.

c. Effective screening of all openings.

d. Sanitary maintenance at all times.

e. Hard surfaced and well marked walkways to permit easy access to the service building from all spaces.

2-25. Water Supply.

1. Mobile home courts and RV campgrounds must be supplied with a safe water supply under pressure. The source and distribution system must be satisfactorily constructed and approved by the State, (in the U.S. or territories) or Naval Facilities Engineering Command and the Bureau of Medicine and Surgery in overseas locations. Water must comply with all the requirements of the Safe Drinking Water Act (National Primary Drinking Water Regulations). A sufficient amount of hot and cold water must be available at all times in service buildings. The source should be capable of supplying at least 150 gallons per mobile home space per day.

2. In mobile home courts, potable water must be provided at each site. An individual water connection must be provided at an appropriate location at each trailer space. The water connection must consist of a riser terminating at least 12-18 inches above the ground surface, with two 3/4 inch valved outlets. The connection must be located at least 10 feet from the sewer connection and be equipped with a backflow prevention device. The potable water outlets must be capped when not connected to a trailer.

2-26. Sewage and Liquid Waste Disposal.

1. A vertical drainpipe with at least a 3-inch connection to the sanitary sewer must be provided at each site in mobile home courts. It is desirable that the connector be a non-collapsible, flexible hose, 3 inches in diameter, and 4 to 5 feet in length. The connection must be equipped with a suitable trap which is located below the frost line. The vertical drainpipes must be securely covered when not in use. The sewer connection must be protected against “wheel damage” by a curb or concrete collar at least 3 inches deep and extending 12 inches from the connection in all directions. The sewer connection must be provided with suitable fittings to permit a watertight junction to be made with the trailer outlet. The connection between the mobile home drain and the sewer must be watertight and self draining. The connection between the vertical drain and trailer must be made in such a manner to exclude insects and rodents, prevent leakage and the escape of odors, and prevent other health hazards or nuisances.

2. Water from toilets, showers, and lavatories must be discharged into an approved public or private sewage system.

3. Mobile home courts are high density communities. Because of this, when a court is to be opened or expanded, special consideration must be given to ensuring that the environmental impact of any proposed sewage treatment system is considered and/or the capacity of an existing system is adequate.

4. A sanitary or dump station must be provided at RV campgrounds for the disposal of sewage and other liquid wastes. It must consist, as a minimum, of a trapped 4-inch sewer riser pipe connected to an approved sewage disposal system. The riser must be surrounded by a concrete apron sloped to the drain. It must have a suitable hinged cover or screw cap and a water outlet to permit periodic wash down of adjacent areas.

7-27. Refuse Disposal.

1. All refuse must be stored in durable, fly-tight, and rodent-proof containers. Refuse containers must be clean, sanitary, and maintained in good repair. Sufficient capacity must be provided to prevent overflowing of any container between collections.

2. All refuse must be collected at least weekly.

3. The burning of trash and refuse is prohibited.

2-28. Insect and Rodent Control.

1. Mobile home parks and RV campgrounds must be periodically inspected by medical department personnel to identify harborage areas or breeding sites for rodents and insect vectors.

2. An effective pest management plan must be in place to eliminate insect breeding sites and/or rodent harborages in and around these locations (see Chapter 8).

2-29. Pets.

1. Pets maybe allowed in the mobile home park *or* RV campground area depending on local command policy. If pets are permitted, they must be under rigorous control at all times. At no time are pets allowed to run loose, nor will they be allowed to create a nuisance or health problem. Pet owners are responsible for cleanup and removal of feces.

2. All pets will be required to have proof of vaccination and registration as required by local regulations.

2-30. Inspections.

1. Inspections of the mobile home courts/campgrounds area must be routinely conducted by management personnel to identify conditions which require preventive maintenance or other corrective action.

2. The medical officer or his/her designated representative must inspect at least quarterly. A report of the conditions observed must be forwarded to the commanding officer, the manager of the mobile home court/campground, and other personnel as appropriate. Emphasis must be placed on health and sanitation. Specific consideration should be paid to conditions which may impact on water quality, insect and rodent control, and nuisance, or other health related conditions.

Section IV. LAUNDRY AND DRY CLEANING

2-31. General.

The purpose of a laundry or dry cleaners is to produce clean garments. Establishments for washing, drying, and dry cleaning range from hand laundries to highly mechanized plants. Sanitary or industrial hazards may occur at any point in the process from delivery of contaminated clothing to the finished product.

2-32. Employees.

1. Employees of laundry and dry cleaning establishments must adhere to the following requirements:

a. Personnel exposed to dry cleaning solvents must receive pre-employment and periodic physical examinations on a schedule determined by the medical officer or higher authority.

b. Personnel working in the processing area of laundries or dry cleaning plants must wear clean, washable outer garments in lieu of street clothing.

c. Personal hygiene must be stressed. Frequent hand washing, particularly after visiting the toilet or handling soiled linen, is mandatory.

2-33. Sanitary Requirements.

1. Laundry and dry cleaning premises must be maintained in a clean and sanitary condition, free from infestation by rodents and insects.

2. Floors must be cleaned at least once daily by dustless methods. Paper and trash must be placed in covered containers; lint must be removed as necessary from bulkheads, overheads, and structural supports.

3. Plumbing fixtures and appliances must be installed in accordance with established standards, maintained in good repair, and kept in a sanitary condition. These fixtures and appliances must be connected to prevent backflow or cross-connections with the potable water supply. Shipboard washing machines have the ability to utilize both fresh water or seawater connections. Fresh and sea water connections must be made in accordance with Naval Ships' Technical Manual, Chapter 655. Sea water may be used when the ship is outside the 50-fathom curve, or 25 miles from shore but never when the ship is in polluted water.

4. Sanitary angle jet type water fountains must be provided to supply drinking water.

5. Adequate toilet facilities with a shower and ample locker space must be provided and maintained in a sanitary condition. A sign stating **'Wash Hands Before Leaving"** must be prominently displayed in all toilet areas.

6. Eating, cooking, smoking, or storage of food, drinks, or smoking material is prohibited in rooms where clothing is handled, sorted, marked, washed, or dry cleaned. If meals or lunches are eaten on the premises, a separate room or space, approved by the medical department, must be provided for this purpose.

7. Laundries and dry cleaning plants must have separate areas designated for receiving and issue. Unwashed clothes must never be received, sorted, marked, or handled in close proximity to washed clothes.

8. Rooms or spaces must be designed and machines and equipment arranged so that a separate flow of clean and soiled garments is maintained throughout the laundry or cleaning process. This flow requires separate contact surfaces, such as tables, carts, shelves, etc. Ventilation must move air from clean to soiled areas to prevent cross contamination.

9. Vehicles and containers used for transportation and storage of laundry and dry cleaning must be kept clean and in a sanitary condition.

10. When present, laundries and dry cleaning plants must be inspected quarterly.

2-34. Hospital/Health Care Facility Laundry.

1. Linen management is included in the standards established by the Joint Commission on Accreditation of Health Care Organizations. Proper linen management is probably best satisfied in Naval Hospitals through a joint effort of the Infection Control Committee, the Preventive Medicine Service, and laundry supervisory personnel. Hospitals/medical facilities using commercial linen services are not relieved of the responsibility for establishing adequate quality assurance procedures.

2. Several aspects of the normal laundering process (hot water wash, bleach, and ironing) reduce the chance of survival of pathogenic microorganisms. Linen handling in hospitals/medical facilities is critical because of the potential for bacterial contamination from infected patients. The recommended method of handling soiled linen is through the use of individual impervious laundry bags for each area. Linen carts must be lined with washable material that can be removed and replaced easily. Linen must only be sorted in the laundry sorting room. Sorting must be done prior to washing by trained personnel wearing clean uniforms, masks, and gloves. Sharp objects, such as broken glass, surgical instruments, etc., are sometimes inadvertently placed in soiled linen. These objects must be carefully removed by sorting personnel. If not removed, the objects may damage machinery and linen.

3. Contaminated laundry from isolated rooms, surgical cases, etc., is often received by laundries. When this occurs, special precautions are required and personnel must be specifically trained on procedures and potential health implications of handling contaminated articles. Contaminated linen must be received in impervious, well sealed double bags. The outer bag must be labeled with the universal biohazard symbol or the word ‘Biohazard” or be red in color. The inner bag must be hot water soluble. Contaminated linen must not be sorted.

2-35. Hygienically Safe Laundry.

1. Normally, articles to be laundered are exposed to hot water at 1600 F containing alkalies, detergents, and/or other chemical cleaning agents. The laundry process is followed by a series of rinses and machine drying.

2. Recent studies indicate that hygienically safe laundry can be processed with warm water laundry formulations (not containing chlorine bleach) at temperatures of 1200 to 1400 F. Hot air dryers area necessary step when chlorine bleach is not included in the formulation. The Centers for Disease Prevention and Control concurs. The BUMED requirement to add a disinfecting agent (chlorine bleach) to warm water (120°-140” F) laundry formulations is hereby rescinded.

3. Laundered articles must be rendered sufficiently free of animal, chemical, and bacterial substances or other materials that may be harmful to persons handling or wearing such articles.

2-36. Industrial Hygiene and Safety

1. Workrooms associated with laundry and dry cleaning operations where machinery or apparatus emit steam, vapors, or heat must be properly ventilated. Such spaces/ operations must be provided with general and/or local exhaust ventilation in order to reduce and/or maintain personnel exposure to potentially hazardous materials/agents within permissible exposure levels. Clean, tempered replacement (or supply) air should be provided. The ventilation system of all dry cleaning equipment must be designed to automatically draw air into the machine upon opening the loading door, thus preventing the release of vapors into the work area. Any proposed changes/modifications to the ventilation system must be referred to the local medical department industrial hygienist for review.

2. All steam and hot water pipes must be insulated with approved (non-asbestos) lagging.

3. Adequate lighting levels must be provided in accordance with appropriate illumination guidelines.

4. When the air concentration of dry cleaning materials exceeds permissible exposure levels, appropriate control measures must be initiated, i.e., administrative, engineering and/or personnel protective equipment. In the event of accidental spills, the proper personal protective equipment, to include respiratory protection, gloves, and apron must, be worn during cleanup operations.

5. Machinery producing potentially hazardous noise/vibration levels must be identified and proper corrective measures initiated. Personnel exposed to sound pressure levels greater than 84 dBA (decibels-A scale) must wear proper hearing protection devices and receive periodic audiometric testing and/or evaluation.

6. Eye protection (safety glasses, goggles, face shields, etc.) is required in operations where splashes may occur such as replenishment of dry cleaning fluid, or the addition of bleaches and detergents. An emergency eye wash station must be provided within the work area.

7. Automatic safety devices on all equipment must be clearly identified, properly maintained, and must not be removed or bypassed.

8. Guardrails must be constructed in connection with ironers, compressors, and other dangerous equipment. Drive shafts, exposed belts, and gears must be enclosed.

9. Signs must be conspicuously posted to warn unauthorized personnel to stay clear of dangerous or restricted areas.

10. First aid kits for emergency use must be provided as required by applicable Occupational Safety and Health Administration (OSHA) regulations.

11. Slippery floors or decks and cluttered aisles are prohibited.

12. Only properly trained personnel may operate flat work ironing machines.

13. Training must be provided in safety, first aid, and use of personal protective equipment.

14. Storage of hazardous and flammable materials used in laundry and dry cleaning processes must be in accordance with current directives.

15. Fire regulations must be prominently displayed and enforced.

Section V. CHILDREN'S PLAYGROUNDS

2-37. General.

Playgrounds are typically located at schools, child care centers, picnic areas, and in family housing. Sustained accident prevention requires careful planning and continued vigilance to ensure that playgrounds remain free of hazards. Playgrounds must be inspected quarterly by medical department personnel with preventive medicine responsibilities. Complete information and requirements concerning the operation of playgrounds is found in OPNAVINST 1700.9C.

2-38. Site Requirements.

1. The site must be reasonably leveled and drained to obtain dryness a maximum number of days in the year. The site should not be completely shaded.
2. It must be free of stone outcropping, gullies, drop-offs, stumps, weeds, animal waste, and trash.
3. Play areas must be fenced to prevent small children from wandering into roadways or other dangerous sites, such as abandoned wells, ravines, or bodies of water.
4. Walkways must be constructed of gravel, concrete, or other suitable materials.
5. If present, trash receptacles must be covered.
6. Energy absorbing surfacing, such as wood chips, sand, shredded tires (non-steel belted), or pebbles, must be used under swings, jungle gyms, slides, and other equipment.

2-39. Playground Equipment.

When playground equipment is provided it must be located away from natural pathways of traffic. Steps leading up to slides must have handrails. There should be guards on seesaws to prevent boards from hitting the ground. Swings offer special hazards which can be minimized by using seats of light-weight material, such as belting, rubber or heavy canvas. Bolts and screws with rounded surfaces must be used in construction of playground equipment. The equipment should have supports of galvanized or painted metal and be firmly anchored in concrete. Concrete anchors must be sufficiently embedded in the soil to preclude them from becoming a trip or fall hazard. Equipment that is improperly installed; rusted, badly worn, or otherwise deteriorated must be repaired or replaced. Playground equipment must be carefully selected and properly placed for the age group for which it is intended. Sufficient space should be allowed between play areas so that children may move freely and safely from one area to another.

Section VI. CAMPGROUNDS AND PICNIC AREAS

2-40. General.

When resources are developed for camping and picnicking, adequate facilities to protect the health and safety of patrons must be provided. Campgrounds and picnic areas must be inspected on a quarterly basis.

2-41. Site Selection.

Campgrounds and picnic sites must be located in such a manner as to protect the areas needed for water-shed, range, and other basic resources. A well drained, gently sloping area is preferred. Sites should be free of rock outcrops and heavy undergrowth. Weeds should be regularly cut to prevent coarse stubble from developing and to reduce insect, snake, and small animal hazards.

2-42. Water Safety.

Campgrounds and picnic areas are frequently located near a body of water. When this is the case, disease, injury prevention, and water safety measures must be taken into consideration. Chapter 4 of this manual should be consulted when a swimming pool or natural bathing place is present.

2-43. Water Supply.

An adequate supply of safe drinking water must be provided at campgrounds and picnic areas. Water hydrant stations with non-threaded, self-closing faucets must be provided within 150 feet of a campsite and individual picnic sites. The area around water hydrants must be properly drained to prevent standing water. In locations where a water system is not possible, a portable water source must be provided at a central pick-up station. Non-potable water systems must be adequately identified to prevent consumption. Campers must also be warned of the dangers in using a stream, lake, or spring as a source of drinking water. If temporary facilities are provided for pop-up trailers and recreational vehicles, adequate potable water and sewage facilities must be provided.

2-44. Refuse Disposal.

Durable, waterproof and rodent proof containers must be provided for refuse disposal. Refuse containers must be located within 150 feet of any campsite. They should be located near access roads to ease refuse collection. Containers should be sufficiently stable to resist being overturned by domestic and wild animals. They must also have fly tight covers and be maintained in a clean and odor free condition at all times. The use of 55-gallon drums as refuse containers should be discouraged. Their large size makes them difficult to empty and clean. The absence of lids makes them attractants for flies, wasps, and other insects. Trash and garbage must be removed daily prior to night-fall. More frequent collections may be necessary. Ashes should be removed from barbecues and the grills cleaned frequently with a coarse bristle wire brush.

2-45. Comfort Stations.

Comfort stations providing flush toilets, lavatories, or other facilities for public use are among the most necessary structures built in the recreation area.

1. In areas where water under pressure is available, modern comfort stations must be located within 300 feet of any campsite and within 500 feet of individual picnic sites. The use of chemical toilets in remote areas may be the only practical solution to sewage disposal, depending on state or local ordinances. Frequent cleaning and maintenance are required to avoid objectionable odors and nuisances in comfort facilities.

2. Permanently constructed comfort stations must be provided with an interior finish of moisture resistant materials which will stand frequent washing and cleaning. The floors, walls, partitions, and interior surfaces must be impervious to water and easily cleanable. Comfort stations must be well lighted, adequately ventilated, and properly protected from the weather. All exterior openings must be covered with 16-inch mesh screen. Doors must open outward and be self closing.

3. When male and female facilities are grouped under one roof, a suitably remote entrance for each section is required. The approaches and entrances must be clearly marked and illuminated. A partition must completely separate the two facilities.

4. Plumbing fixtures must be provided as outlined in figures 2 and 3. Soap (solid, liquid or powder), paper towels or air dryers, and trash containers must be provided. The facilities must be thoroughly cleaned daily or more frequently if required.

Figure 2-2. Comfort Stations for Campgrounds

NUMBER OF SITES	COMMODES MALE	COMMODES FEMALE	LAVATORIES MALE	LAVATORIES FEMALE	URINALS
1-20	1	2	1	2	1
21-30	2	3	2	2	2

Figure 2-3. Comfort Stations for Picnic Areas

CAR PARKING SPACES	COMMODES MALE	COMMODES FEMALE	LAVATORIES MALE	LAVATORIES FEMALE	URINALS
1-40	1	2	1	2	1
41-80	2	4	2	2	2

conducted by medical department personnel with preventive medicine responsibilities.

2-47. Equipment.

Sports and physical fitness related equipment must be of an acceptable design and constructed to prevent injury due to structural defects. All equipment must be maintained in safe operating condition.

2-48. Structural.

1. Floors. All playing surfaces, running tracks, passageways, and other floors must be maintained free of spills, debris, uneven surfaces, protrusions and obstacles that may increase the potential of injury.

2. Walls and ceilings must be reasonably smooth, easily cleanable, light colored, and maintained in good repair. Walls in close proximity to basketball and other similar sports must be suitably padded to reduce physical injury.

3. Mats and other cushioning devices must be adequately maintained and cleaned routinely.

2-49. Lighting.

Gymnasiums must be adequately illuminated for spectator or recreational sporting activities. Locker rooms and other areas must also be properly illuminated. All luminaries must be adequately shielded to protect them from damage or breakage from projectiles. Mercury vapor and halide bulbs must be equipped with self-extinguishing mechanisms or be completely enclosed by a shield that absorbs ultraviolet radiation.

2-50. Toilet Facilities.

Separate toilet facilities with water closets, lavatories and urinals as appropriate must be provided for male and female staff and spectators. The facilities must be physically separated from patron shower and locker rooms. Shower/locker rooms must be fitted with adequate lockers, showers, water closets, urinals, and lavatories to accommodate the needs of patrons. The handwashing facilities must be provided with NSF approved cloth towel dispensers or disposable towels and liquid, solid or powdered soap. All toilet and shower facilities must be maintained in a clean sanitary condition free from plumbing defects. Suitable trash containers must be placed in all toilet and locker rooms. Refuse containers must be emptied at sufficient intervals to prevent overflow of refuse.

2-51. Drinking Fountains.

Drinking fountains must be provided to accommodate staff, patrons and spectators. Drinking fountains must be cleaned daily with particular emphasis on the bowl, orifice and orifice guard. Drinking fountains must be the angle jet type.

2-52. Recreational Clothing Rental/ Issue.

Some facilities have the capability of issuing or renting recreational clothing, (shorts, towels, etc.) for use by patrons. The medical department (preventive medicine service) must review and approve the procedures associated with the issue of such items. Laundry facilities within the facility, if adequate and approved, are acceptable.

Section VIII. THEATERS

2-53. General.

The head of Moral Welfare and Recreation is responsible to commanding officers for the operation of theaters at Navy and Marine Corps activities. Included in this responsibility is the elimination of any condition that could adversely affect the health of patrons. Navy and Marine Corps theaters must be inspected periodically by management and medical personnel with preventive medicine responsibilities. These inspections should focus on identifying discrepancies in housekeeping and insect and rodent control.

2-54. Construction Standards.

Minimum construction standards, including ventilation, heating and cooling are included in the Department of Defense Construction Criteria Manual. Adherence to these standards is required in order to protect the health, comfort, and safety of patrons.

2-55. Housekeeping Requirements.

The entire theater, all corridors, aisles, stairways, drinking fountains, and patron seats should be cleaned daily before the building is secured. Waste containers must be emptied as necessary and prior to closing. Food or drink spillage should be cleaned as it occurs or at the next intermission. Unnecessary combustible material is not to be stored in the building or immediate area. Evidence of insects and rodents must be promptly reported by trouble call or work request.

2-56. Food Service.

Snack bars, refreshment stands, vending machines, etc., must be operated in accordance with NAVMED P-5010-1.

2-57. Safety.

Seats must, be in good condition with no splinters or protruding nails. Carpets and floors must be periodically checked for worn or frayed edges which could result in tripping. Fire exits must open outward, be equipped with illuminated signs, be properly located, adequate in number, and equipped with panic bars. Fire exits must never be locked with chains or other devices which may hinder safe egress.

Section IX. RIDING STABLES

2-58. General.

1. The primary environmental health concern associated with horses is the stabling of these animals and related waste disposal. Accumulation of animal feces provides a breeding place' for flies and creates a persistent source of odors. Flies constitute a public health hazard because of their potential for mechanically transmitting disease. Elimination of fly breeding sites is essential to fly control.

2. Riding stables must be inspected at least quarterly by preventive medicine personnel.

2-59. Stables and Corrals.

1. To minimize potential odor and nuisance problems, horses must be stabled in a location removed from, but accessible to, the main recreation center of the activity.

2. Stables must be located on a well drained site. Buildings must be of durable construction to prevent deterioration and/or rodent and insect infestations. Floors in horse stalls must be paved with wooden blocks sealed in asphalt or other impervious material, except concrete. Stall floors must be sloped to facilitate proper drainage. Floors in general storage rooms must be of concrete construction so they can be hosed down and maintained in a clean, odor free condition. A sufficient number of hose bib outlets, equipped with suitable backflow prevention devices must be provided throughout the stable for this purpose.

3. The stable must be provided with an adequate drainage system so that all liquid waste can be satisfactorily drained away from the stable facilities. Corrals and paddock areas should be gently sloped to facilitate natural drainage and minimize standing pools of surface water. A drinking water trough must be provided in the corral for watering animals.

2-60. Water.

Water for employees and patrons must be provided in accordance with the Safe Drinking Water Act. If a well is used as the source of drinking water it must be located at least 100 feet from the stable and paddock sites or the areas where they drain. Untreated well water may be used for watering animals, but such supplies are not acceptable for employees and patrons. To avoid accidental human consumption, non-potable water systems must be plainly labeled, ‘WATER UNSAFE FOR DRINKING.” Every effort must be made to ensure that no cross connections exist between potable and non-potable systems.

2-61. insect and Rodent Control.

The stable must be of rodent proof construction. Openings to the outside must be effectively screened when feasible to prevent the entry of flies and other insects. Feed grains must be stored in rodent proof containers. Feed storage areas must be periodically inspected by medical department representatives for evidence of insect or rodent infestation.

2-62. Waste Disposal.

1. Adequate toilet facilities must be provided for employees and patrons. Separate facilities must be provided for males and females.

2. Manure must be removed and stored or disposed of in accordance with state/local laws and ordinances. Manure must be removed from the stalls and corrals at least once each day, preferably in the early morning.

3. Storage and disposal must be accomplished in a manner that prevents contamination of run-off water.

2-63. Veterinary Service.

The operation of the stable must be under the professional guidance of a veterinarian, either military or contract civilian. If the boarding of privately owned horses is permitted, health certification from a licensed veterinarian, including vaccination records, must be provided before the animal is accepted into the stable.

Section X. SANITATION OF ADMINISTRATIVE SPACES

Article

2-64. General.

A significant proportion of military and civilian personnel work in administrative spaces. Clean administrative spaces with adequate lighting, heating, cooling and ventilation enhances morale and promotes productivity. When compared to industrial work spaces, such as shops, engineering spaces, storerooms, and warehouses, there is less chance of occupational injury or disease transmission; nevertheless, injuries do occur and the possibility of disease transmission does exist. Surveys of administrative spaces should be conducted in response to trouble calls or to resolve discrepancies identified during administrative inspections. Evaluations of health concerns in administrative spaces often require a multi-disciplined survey team including environmental health officers, industrial hygienists, etc.

2-65. Habitability.

1. A healthy environment is essential in administrative spaces ashore and afloat to maintain the efficiency of Navy and Marine Corps personnel.

2. The shipboard habitability program, procedures, category standards, requirements, and responsibility are outlined in Naval Sea Systems Command directives and OPNAVINST 9640.1 series.

a. Ventilation for surface ships requires minimum replenishment with outside air at the rate of 5 cubic feet per minute per occupant. OPNAVINST 5100.19C (Vol 1), concerning heat stress is applicable. Air conditioning of administrative spaces is a design goal which must be considered on an individual basis.

b. Noise standards in administrative spaces are such that direct speech communication must be understood with minimum error and without need for repetition.

c. *General Specifications for Ships of the U.S. Navy* require lighting fixtures to be arranged to provide uniform illumination so that the ratio of maximum foot candles under a lighting fixture to the minimum foot candles between it and the nearest adjacent fixture is not greater than two to one.

3. Requirements for shore facilities are found in the Department of Defense Construction Criteria Manual. The following standards apply to administrative offices and spaces.

a. The net floor area per building occupant must not be less than 115 square feet and not more than 130 square feet.

b. The minimum ratio of plumbing fixtures to the number of persons to be accommodated appears in table 2-3.

c. Air conditioning, evaporative cooling, dehumidification, mechanical ventilation, and type of heating is determined by the climatic zone in which the facility is located. Heating systems must, while operated at rated capacity, maintain an inside temperature of 68 degrees F in administrative spaces.

Table 2-3. Ratio of Plumbing Fixtures to Persons

OCCUPANTS	WATER CLOSETS	LAVATORIES	URINALS	DRINKING FOUNTAIN
MALE				
up to 30	1/15	1/20	1/30	1/75
31 to 120	1/20	1/20	1/40	1/75
FEMALE				
up to 120	1/15	1/15	None	1/75

d. Lighting Intensities for Administrative Spaces Ashore: Lighting intensities must conform to the guidelines established in the current edition of the Illuminating Engineering Society (IES) Lighting Handbook. The intensity of the general illumination for any area must not exceed 150 foot candles. If a higher intensity is required for a particular task, it must be achieved by supplementing the general illumination with localized (supplementary) lighting. The ratios between general and supplementary illumination must be at least those recommended by IES. Supplementary lighting fixtures must be reviewed and approved by safety personnel prior to installation.

2-66. Sanitation and Housekeeping.

1. Administrative spaces ashore and afloat must be kept clean with no evidence of insects and rodents. Afloat, insect and rodent control is a medical department responsibility. Ashore, the medical department is responsible for inspections and surveys; the public works department is responsible for treatment and control. Administrative personnel must report the presence of insects or rodents to public works by trouble call or work request.

2. Floors should be cleaned daily. The type of floor determines the method of cleaning. Carpets and rugs should be maintained as recommended by the manufacturer. Painted surfaces must be cleaned periodically to prevent accumulation of dirt.

3. Trash receptacles must be emptied daily and cleaned periodically. Disposable liners are recommended.

4. Drinking fountains should be cleaned at least once daily with particular emphasis on the bowl, orifice, and orifice guard. Drinking fountains must be of the angle jet type.

5. Head facilities must be cleaned and resupplied daily.

6. Mops, brooms, brushes, and other cleaning gear must be thoroughly cleaned and properly stored after each use.

7. Cleaning contracts for administrative areas must provide a specified cleaning schedule in the basic contract.

8. Cooking is not permitted in administrative areas; designated lounges can be utilized, if inspected and approved by medical department personnel,

Section XI. SAUNAS AND STEAM ROOMS

2-67. General.

Saunas and steam rooms are used for relaxation or as part of an individual physical fitness program. Saunas operate on the principle of inducing perspiration through high temperature dry heat, whereas steam rooms use moist heat. Saunas and steam rooms must be structurally sound, clean, and free of any potentially dangerous condition.

2-68. Structure.

1. General. Constructive must be no less than industry standards and be approved for installation by the cognizant Engineering Field Division, Naval Facilities Engineering Command. Electrical installation must be in accordance with current Naval Facilities Engineering Command standards. Doors must contain window(s) which allow observation of the entire room. Lighting must be in accordance with current Illumination Engineering Society Standards. Carpet and/other absorbent floor coverings are prohibited.

2. Sauna. Saunas must be constructed of rot resistant woods (e.g., redwood). The floor must be covered with buckboards designed for easy removal and cleaning. Benches must be designed to allow easy cleaning with no hard-to-reach locations. Benches must be maintained in good structural repair. Seating surfaces must be smooth without splintering, protruding nails, or other fasteners that may cause injury.

3. Steam Rooms. Steam rooms must be completely lined with impervious material (e.g., ceramic tile) which will not deteriorate under moist heat conditions. The walls, floors, and ceiling must be maintained in good repair. Benches must be constructed and installed to permit easy cleaning.

2-69. Sanitation.

The interior of saunas, steam rooms, and associated changing areas (see Article 2-50) must be clean and free of debris, foul odors, or other unsanitary conditions. The floor, buckboards, benches, or platforms must be scrubbed daily using a mild detergent followed by an EPA registered disinfectant (e.g., 50 ppm chlorine solution) or commercial cleaner/sanitizer. The consumption of food or drink in saunas or steam rooms is strictly prohibited. The sanitary condition of a sauna or steam room should be determined in conjunction with the inspection of the facility in which it is located.

2-70. **Safety.**

A thermostatic; control device must be installed which prevents saunas and steam rooms from exceeding 200° F (93° C) and 120°

F (49° C) respectively. Signs must be conspicuously posted listing rules for operation and use. If for any reason a sauna or steam room is equipped with a door lock, the door must be easily opened from inside the room. Steam outlets, piping, and heaters must be shielded to prevent burns. Saunas and steam rooms which are located in remote sites, away from pedestrian traffic, should be equipped with an alarm or equivalent system which can be activated by the patron in an emergency.

SECTION XII. **REFERENCES**

2-71. References.

The following is a list of publications used in the preparation of this chapter. Copies should be on hand or available to medical department personnel for reference and guidance. State and local guidance should also be consulted, and procured as necessary. Revisions and supplements are published as necessary and personnel must ensure that they are on the distribution list to receive current editions.

1. DoD Instructions

DoD 4270. l-M, Department of Defense Construction Criteria Manual

2. Navy Instructions

a. SECNAVINST 1640.9 series, Department of the Navy Corrections Manual

b. OPNAVINST 1700.9 series, Child Development Programs

c. OPNAVINST 1640.7 series, Manual for the Operation of a Waterfront Brig/Correctional Custody Unit.

d. OPNAVINST 1640.8 series, Manual for the Administration of Afloat Brigs.

e. OPNAVINST 5090.1 series, Environmental and Natural Resources Protection Manual.

f. OPNAVINST 5100.19 series (Vol 1), Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat

g. OPNAVINST 5100.23 series, Navy Occupational Safety and Health Program Manual

h. OPNAVINST 9640.1 series, Shipboard Habitability Program.

i. OPNAVINST 11103.1 series, Adequacy, Assignment, and Utilization of Bachelor Quarters (BQ)

j. BUPERSINST 1710.11 series, Navy Recreation Operational Policies

k. NAVMEDCOMINST 6260.5 series, Occupational Noise Control and Hearing Conservation.

1. NAVMEDCOMINST 6770.1 series, Linen Management

3. Navy Publications

a. General Specifications for Ships of the United Stats Navy, NAVSEA S9AAO-AA-SPN-010/GEN-SPEC.

b. Navy Bachelor Quarters Manual, NAVPERS 15606

c. Naval Ships' Technical Manual, Chapter 655, Laundry

d. Naval Ships' Technical Manual, Chapter 670, Stowage Handling, and Disposal of hazardous General Use Consumables

e. NAVFAC DM-4, Electrical Engineering

f. NAVFAC DM-37.4, Brigs, Detention Facilities

g. NAVMED P-117, Manual of the Medical Department

h. NAVMED P-5010-3, Ventilation and Thermal Stress Ashore and Afloat

4. Non-DoD Publications

a. *"Environmental Health Guide for Mobile Home Communities,"* U.S. Department of Health Education, and Welfare, Public Health Service, Revised 1975. Available from: Mobile Home Manufacturers Association, 14650 Lee Road, Chantilly, VA 22021

b. Title 29, Code of Federal Regulations, Part 1910.37 (29 CFR 1910.37) "General Industry," OSHA Safety and Health Standards

c. Title 29, Code of Federal Regulations, Part 1910.1030 (29 CFR 1910.1030), *Control of Occupational Exposure to Bloodborne Pathogens*

d. Title 29, Code of Federal Regulations, Part 1926.50 (29 CFR 1926.50), *Medical Services and First Aid*

e. "*Health and Safety Hazards at Recreation Areas,*" National Environmental Health Association, 1982.

f. "*Illuminating Engineering Society (IES) Handbook,*" Illuminating Engineering Society, 345 East 47th Street, New York, NY 10017.

g. "*Manufactured Home Installations*" American National Standards Institute A225.1, National Fire Protection Association 501-A (joint publication)

h. "*Mobile Home Court Development Guide,*" U.S. Department of Housing and Urban Development

i. PHS Publication No. 1195, "*Environmental Health Practice in Recreation Areas,*" reprinted 1978.

j. *Sanitarian's Handbook, 1977* Edition, Ben Freedman, M. D., M.P.H.

Naval Medical Command

Washington DC 20372-5120

NAVMED P-5010-3
(1988)
0510-LP-2O2-87OO

Manual Of Naval Preventive Medicine

Chapter 3

VENTILATION AND THERMAL STRESS ASHORE AND AFLOAT

DISTRIBUTION STATEMENT "A"

0510LP2026700

CONTENTS

Page

VENTILATION AND THERMAL STRESS ASHORE AND AFLOAT

Chapter 3

Section I. DEFINITIONS AND INSTRUMENTATION

3-1. Purpose

(1) The purpose of this chapter is to provide information on the fundamentals of heating, ventilating and cooling, and to describe the physical and physiological measurements which must be made ashore and afloat in order to assess the effects of hot and cold atmospheric conditions on personnel.

(2) Engineering aspects which relate to heating, ventilation and cooling design in shipboard situations come under the cognizance of the Naval Sea Systems Command; those applying to shore establishments are handled by the Naval Facilities Engineering Command. Health standards governing these installations are promulgated by the Naval Medical Command. In order to protect the health and well-being of all personnel, it is important to be familiar with the fundamental principles involved in heating, ventilation and air-conditioning as they apply to the human.

3-2. Definitions and Instrumentation

(1) *Stress and Strain*

(a) The thermal (heat or cold) stress of any given working situation is the combination of all of those factors which result in heat gains or losses relative to the body or which prevent the body's regulatory mechanisms from working efficiently. Thus, it is necessary to consider the combined impact of climatic and non-climatic factors and to evaluate independent and integrated influences associated with the human.

(b) In accordance with engineering practices, environmental physiologists employ the term "stress" to designate the force or load acting upon the biological system and the term "strain" to designate the resulting distortion of the biological system. Thermal *stress* factors are conventionally given as heat, cold, humidity, radiation, air movement and surface temperatures; thermal *strain* manifests itself in specific cardiovascular, thermoregulatory, respiratory, renal, endocrine, etc., responses which differ from accepted human norms.

(c) It must be understood that not all thermal stress and strain are adverse to humans. Within the range of human adaptability, factors that do not impair performance or increase susceptibility to other risks may be considered "acceptable" until proven otherwise. Due to the fine line between acceptable and unacceptable levels of heat stress and strain, extreme caution must be exercised to avoid cumulative harm to individuals.

(d) Thermal stress has been categorized as:

(1) "Acceptable" when the human is *able to compensate without undue strain;* or,

(2) "Unacceptable" when the human is *able to compensate but incurs severe strain,* or is *unable to compensate and incurs excessive strain.*

(e) Thermal strains have been categorized as:

(1) Those interfering with work performance and safety; and,

(2) Those with more overt manifestations of physiologic decomposition such as heat rash, heat cramps, heat exhaustion, heat stroke, non-freezing or freezing injuries.

(2) *Climatic Measurements of Thermal Stress:*

(a) *Dry-Bulb Temperature* (DB) of air is that temperature measured with an ordinary alcohol-in-glass, or mercury-in-glass, thermometer whose bulb is kept dry and shielded from radiation. When laypersons speak of the prevailing air temperature, determined from a conventional thermometer, they are speaking of the dry-bulb temperature. A variety of electronic sensors can be used in place of conventional thermometers; if properly constructed some of these (e.g., thermocouples and thermistors) may require comparatively little shielding from radiant heat transfer. For routine monitoring of dry-bulb temperatures in shipboard spaces, the Naval Sea Systems Command approved alcohol-in-glass dry-bulb thermometer has the stock number 9G-6685-00-243-9964.

(b) *Wet-Bulb Temperature* (WB) is measured with a thermometer, similar to that used for dry-bulb temperature, except that a wet wick is fitted closely over the bulb (or sensor). A "natural" wet-bulb temperature is defined as that obtained with no additional movement of air over the wick than that which occurs naturally in the environment. An "aspirated" wet-bulb temperature is obtained by increasing air movement over the wick with a fan, motorized psychrometer, or sling psychrometer. The "true" wet-bulb environmental temperature is approximated with an air flow of at least 250 feet per minute (fpm) over the wick and the bulb is shielded from radiant heat. Excessive air velocity (e. g., greater than 1500 fpm) may result in a significant degree of kinetic heating. Although the natural wet-bulb temperature depends on the dry-bulb temperature and the moisture content of the air, it does not provide a direct indication of the amount of water vapor in the air. The *aspirated* wet-bulb temperature is therefore of greater value in planning corrective engineering actions than the "natural" wet-bulb temperature, and the term *wet-bulb* will hereafter refer to that which is *aspirated* unless otherwise specified.

When the wet- and dry-bulb temperatures are identical the air is said to be "saturated;" and the relative humidity may be considered to be 100 percent. Any decrease in the moisture content of the air will result in evaporation from the wetted wick of the wet-bulb thermometer, and in turn, the bulb of the thermometer will be cooled to a temperature which reflects the reduced moisture content of the air.

(c) *Measurements of Humidity.* Humidity is an expression of the quantity of water vapor mixed with the other atmospheric gases. The Absolute *Humidity* (AH) is the mass of water vapor present per unit volume of air (kg/m'); the gas pressure (Torr) exerted by this water vapor is referred to as the *Vapor Pressure (e* or VP). The ratio of the actual amount of water in the air (absolute humidity) to the maximum quantity of water that the air can hold at a given temperature is the *Relative Humidity* (RH). The temperature at which the absolute humidity reaches a maximum and the air become saturated with water vapor is called the *Dew Point* (Td).

Vapor pressure is a measure of water content in the atmosphere under given conditions. Relative humidity is primarily a ratio of partial and saturated vapor pressures, not a measure of water content. For example, one may find a 50 percent relative humidity at 50 F DB and 100 F DB, but the actual water content at 100 F DB will be nearly six-fold greater than that at 50 F DB (See Figure 3-1). Therefore, the proper evaluation of thermal conditions requires specifying both dry- and wet-bulb temperatures.

(d) *Psychrometer—an* instrument for measuring atmospheric humidity utilizing a dry- and wet-bulb thermometer and whirled manually or by motorized unit to provide the moderate air flow necessary to obtain an aspirated wet-bulb temperature reading. Psychometric charts (Figure 3-1) help translate this information into relative humidity and other thermodynamic characteristics of moist air. It is strongly recommended that *motorized psychrometer* be used for reproducibility of measurements; in turn, the stock number for the approved unit is 1H-6685-00-935-1389, calibration is not required. Electronic, motorized psychrometer are available to provide direct readout of DB, WB, RH and Td.

(e) *Air Movement or Velocity* (V) is usually expressed in feet per minute (fpm) or cubic feet per minute (cfm). It is measured by various instruments depending upon the velocities of air movement. Low velocities (down to 10 fpm) require a heated Kata thermometer or thermo-anemometer ("hot-wire" anemometer or equivalent); high unidirectional air velocities may be measured with a velometer or vane anemometer.

(f) *Radiant Heat is* the transfer of thermal energy by wave motion from one object to another without warming of the intervening space. The wave lengths involved range from the visible portion of the electromagnetic spectrum (0.3-0.7 microns) to the longer radio waves. In industrial situations any part of the heat radiation spectrum may be present. Natural environments, however, generally include two bands: solar radiation from ultra-violet to near infrared, and heat radiation in the far infrared portion of the spectrum. For recall it is easier to remember that solar radiation is a shorter wavelength and heat radiation (e.g., indoors) is a longer wavelength. Both forms of radiation liberate thermal energy when absorbed.

Not all of the radiant heat that strikes a surface is absorbed. Any surface which has a high reflectance will minimize absorption of radiant heat; conversely, a surface with low reflectance will increase absorption of radiant heat. The portion that is absorbed is termed "absorptance of the surface" while that which is not absorbed is reflected by the "reflectance of a surface". An exception exists for humans in that dark-pigmented skin and light-colored skin are essentially alike in absorbing the longer wavelength radiant heat (e. g., indoors); however, in the sunlight darker skin has a higher absorptance than lighter skin. The intensity of radiant heat can be measured by use of a radiometer or pyrheliometer, or a globe thermometer.

(g) *Globe Thermometer (G).* The Vernon Globe Thermometer consists of a 6-inch hollow copper sphere, with a 0.022 inch thick wall, painted matte (flat) black on the outside, and contains a temperature sensor like that of an unshielded dry-bulb thermometer with its bulb, or an equivalent, at the center of the sphere. A Vernon globe requires about 20 minutes to achieve equilibrium. Smaller globes, from 1.64-4.0 inch outside diameter, have been developed which have shorted equilibrium times; however, few have been demonstrated to be equivalent with a Vernon Globe. Globe thermometers are required in the assessment of thermal stress because they integrate radiant heat exchange and convective heat loss into a single value.

(h) *Wet-Bulb GIobe Temperature* (WBGT) *Meter,* also known as the Heat Stress Meter, is a compact electronic instrument that independently measures the dry-bulb, wet-bulb and globe temperatures. The instrument displays each of these values as well as computes and displays the WBGT Index value (described in Section IV). The approved Navy Heat Stress Meter (7G-6685-01-055-5298) is lightweight, self-contained, and equipped with a rechargeable power supply. A ventilating fan is included, in the shielded dry- and wet-bulb sensor assembly, to obtain aspirated wet-bulb temperatures. The entire unit can be adapted for remote monitoring and recording. Use and maintenance of the Navy's Heat Stress Meter is described and portrayed in the Navy educational film "Care and Use of the Heat Stress Meter" (35335-DN). Use of other electronic and

Figure 3-1. —Psychrometric Chart.

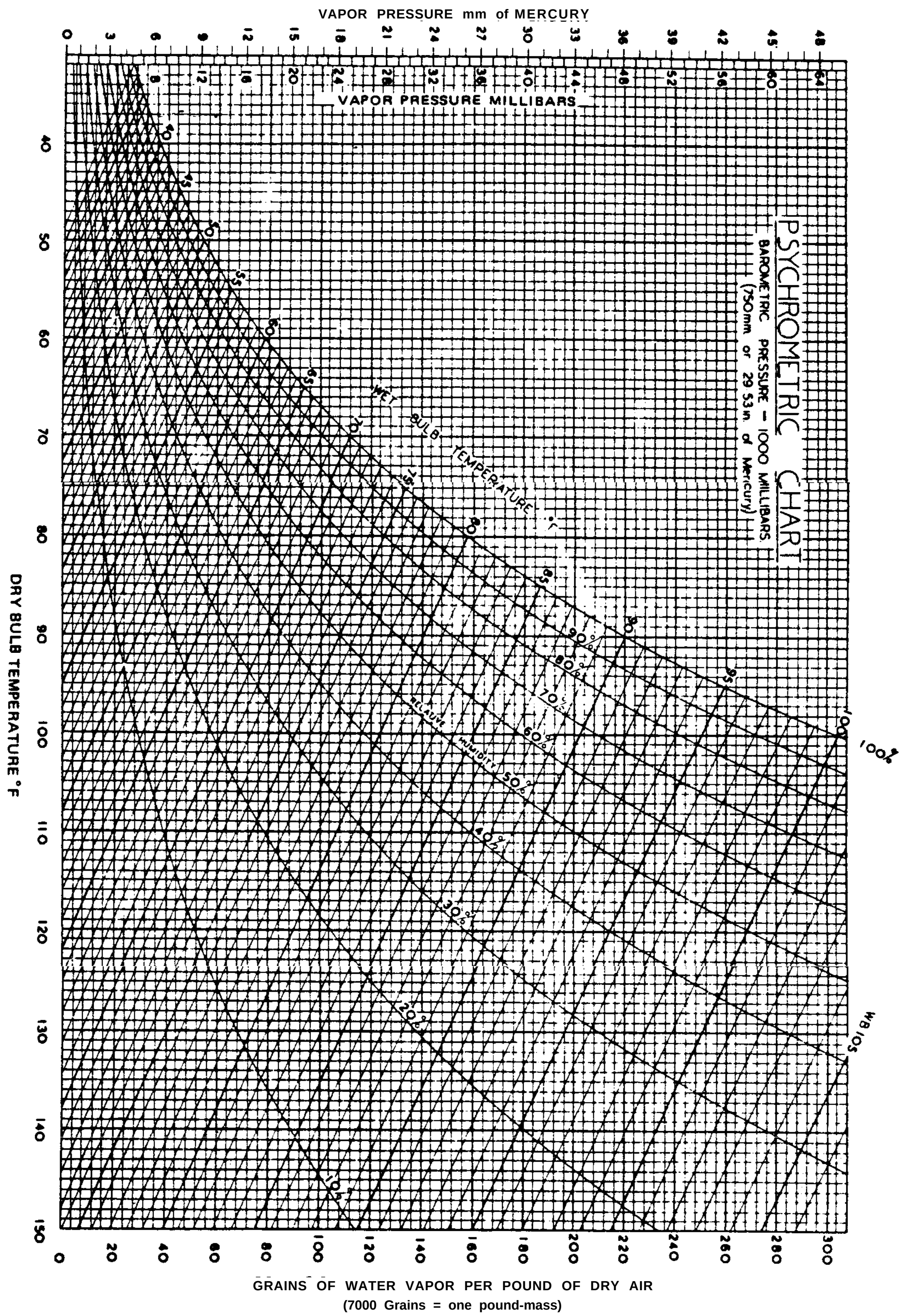


Figure 3-1.—Psychrometric Chart.

manual heat stress monitoring devices, other than a motorized psychrometer, are not approved for shipboard purposes unless the proposed devices meet the accuracy and response time test accuracy tolerances given in Table III and Figure 3 of Navy Procurement Specification 0513487126-SGA of 20 May 1987. No manual "heat stress monitors," which supposedly provide dry- and wet-bulb and globe temperatures and/or a so-called facsimile of the WBGT Index, are approved for shipboard uses due to inherent measurement errors over the wide range of thermal environments that exist throughout Navy ships. Special heat stress survey teams, from shore activities, should employ the most reliable, accurate equipments available. Inquiries regarding approval for shipboard use and for comparative purposes should be brought to the attention of MED-22. Naval Medical Command approval for shipboard uses can only be considered after receiving and evaluating a diversity of comparative data for each type of proposed alternative heat stress monitoring device.

Stock numbers for the Navy approved WBGT Meter, accessories kit, globe assemblies alone and rechargeable batteries, as of May 1988, are:

(a) WBGT Meter 7G-6685-01-055-5298 (Shipboard AEL 2-870003051)

(b) Accessories (spare sensor/wind tunnel assembly, globe, wicks, etc.) 9G-6685-01 -055-5299 (Shipboard APL 100110001)

(c) Globe Assemblies 9G-6665-01-149-8635

(d) Standard Nickel-Cadmium Rechargeable AA Batteries 9G-6140-00-449-6001

(i) *The Infrared Thermometer* (self-contained electronic) is used to measure the temperature of infrared energy emitted from various sources. The practical aspects of an infrared thermometer are that no contact with surfaces is required. In industrial settings, a lightweight, hand-held infrared thermometer allows scanning of surfaces to detect the functional adequacy of insulation, as well as to check overheating of equipments. Analog and digital readout and imaging devices are commercially available. In all applications, extreme caution should be exercised in using infrared thermometers. A number of such devices require the instrument to be four feet or more from the infrared sources to avoid infrared "flare". Electromagnetic radiation "flare" will result in erratic values, leading to misinterpretations of the data.

(j) *Effective Temperature* (ET) is an empirical sensory index, combining into a single value the effects of temperature, humidity, air velocity and thermal radiation. Combinations of conditions which produce the same subjective feeling of warmth in reference to still air are assigned the same effective temperature.

(k) *Equivalent Temperature is* commonly known as "Wind *Chill"*. As noted by Burton in 1955, "Wind Chill" lacks a scientific basis. The product of calculating "Wind Chill" is a heat transfer factor, and the relationship of temperature and air movement provide the derived heat transfer. The temperature—air movement relationship is known as the *Equivalent Temperature. (See* Article 3-14)

(1) *The Mean Radiant Temperature* (mrt) of a nonuniform environment (e.g., walls, overhead, deck and objects of different emissivities and at different temperatures) is defined as the temperature of a uniform black enclosure in which a solid body or an occupant would exchange the same amount of radiant heat as in the given nonuniform environment. It is estimated from dry-bulb and globe temperatures and air movement and is useful in determining radiative heat transfer (net gain or loss) relative to humans. Section IV provides further information on mean radiant temperature.

manual heat stress monitoring devices, other than a motorized psychrometer, are not approved for shipboard purposes unless the proposed devices meet the accuracy and response time test accuracy tolerances given in Table III and Figure 3 of Navy Procurement Specification 0513487126-SGA of 20 May 1987. No manual "heat stress monitors," which supposedly provide dry- and wet-bulb and globe temperatures and/or a so-called facsimile of the WBGT Index, are approved for shipboard uses due to inherent measurement errors over the wide range of thermal environments that exist throughout Navy ships. Special heat stress survey teams, from shore activities, should employ the most reliable, accurate equipments available. Inquiries regarding approval for shipboard use and for comparative purposes should be brought to the attention of MED-22. Naval Medical Command approval for shipboard uses can only be considered after receiving and evaluating a diversity of comparative data for each type of proposed alternative heat stress monitoring device.

Stock numbers for the Navy approved WBGT Meter, accessories kit, globe assemblies alone and rechargeable batteries, as of May 1988, are:

(a) WBGT Meter 7G-6685-01-055-5298 (Shipboard AEL 2-870003051)

(b) Accessories (spare sensor/wind tunnel assembly, globe, wicks, etc.) 9G-6685-01-055-5299 (Shipboard APL 100110001)

(c) Globe Assemblies 9G-6665-01-149-8635

(d) Standard Nickel-Cadmium Rechargeable AA Batteries 9G-6140-00-449-6001

(i) *The Infrared Thermometer* (self-contained electronic) is used to measure the temperature of infrared energy emitted from various sources. The practical aspects of an infrared thermometer are that no contact with surfaces is required. In industrial settings, a lightweight, hand-held infrared thermometer allows scanning of surfaces to detect the functional adequacy of insulation, as well as to check overheating of equipments. Analog and digital readout and imaging devices are commercially available. In all applications, extreme caution should be exercised in using infrared thermometers. A number of such devices require the instrument to be four feet or more from the infrared sources to avoid infrared "flare". Electromagnetic radiation "flare" will result in erratic values, leading to misinterpretations of the data.

(j) *Effective Temperature* (ET) is an empirical sensory index, combining into a single value the effects of temperature, humidity, air velocity and thermal radiation. Combinations of conditions which produce the same subjective feeling of warmth in reference to still air are assigned the same effective temperature.

(k) *Equivalent Temperature is* commonly known as "Wind *Chill"*. As noted by Burton in 1955, "Wind Chill" lacks a scientific basis. The product of calculating "Wind Chill" is a heat transfer factor, and the relationship of temperature and air movement provide the derived heat transfer. The temperature—air movement relationship is known as the *Equivalent Temperature. (See* Article 3-14)

(1) *The Mean Radiant Temperature* (mrt) of a nonuniform environment (e.g., walls, overhead, deck and objects of different emissivities and at different temperatures) is defined as the temperature of a uniform black enclosure in which a solid body or an occupant would exchange the same amount of radiant heat as in the given nonuniform environment. It is estimated from dry-bulb and globe temperatures and air movement and is useful in determining radiative heat transfer (net gain or loss) relative to humans. Section IV provides further information on mean radiant temperature.

Section II. DESIGN OBJECTIVES

3-3. Objectives of Heating, Ventilation and Cooling

(1) Major objectives of heating, ventilation and cooling include maintaining physical fitness, mental alertness, fighting ability and the general well-being of personnel in the performance of their duties ashore or afloat. This should include consideration for the stresses of watches, prolonged cruising and battle or general quarters situations. The design and maintenance of environmental control systems should assure useful productivity and recovery from undue physical stress rather than thermal comfort alone.

(2) In addition to temperature considerations, environmental control systems must assure that the air in confined spaces contains sufficient quantities of oxygen and no harmful components.

(3) Special use areas such as selected Medical Department spaces, and those containing equipment and materials which require individually controlled surroundings, must be designed to guarantee optimal mission performance under variable environmental conditions.

Designs must address exhaust of gases and vapors which are heavier than air, therefore, in both shipboard and ashore applications, exhaust ventilation is required nine inches from the deck. Furthermore, just because the design supply air volumes and exhaust volumes meet design specification, optimal distribution within the space or the work site must be assured.

3-4. Heating

(1) In designing a heating system ashore, the relatively narrow range of climatic conditions in a given locale can usually be anticipated and the system designed accordingly. This sort of planning is obviously difficult for naval vessels on which heating systems must be designed to provide for a wide range of climatic conditions from arctic cold in winter to tropical heat in summer. The need for design flexibility is further extended by variable requirements for space, weight and power sources. In addition, the distance of the heating (or cooling) unit from the point of delivery must be considered. For general purposes in cold weather, the amount of heat supplied should be planned to balance heat loss when the outside air temperature is 10 F DB and the sea water temperature is 28 F, the air temperature at normal work stations should be sustained at least to 65 F.

(2) Aboard ship the conventional approach for heating is accomplished by drawing fresh outside air over heating coils and discharging the heated air into various compartments where it is required. In order to avoid condensation of moisture on and inside the air ducts and to provide a flexible heating system, outside air is initially preheated to 42-50 F DB. The air is then heated to the desired delivery zone temperature and distributed to the various compartments and spaces within that zone. A “heating zone” is defined as a group of adjacent spaces with approximately the same heating requirements.

(3) A zone temperature of 70 F DB is required aboard surface vessels for berthing, dressing, lounge, messing, medical, dental, office and control spaces. No effort is made to maintain a controlled moisture level in these spaces during cold weather; therefore, Medical Department personnel should anticipate increased symptoms associated with the drying of respiratory membranes among individuals working in these areas.

(4) Heating designs for submarines differ from those of surface vessels in that they provide a regulated humidity for the living and control spaces noted above. Symptoms associated with the drying of the respiratory membranes may be less pronounced than those noted aboard surface vessels. The heating design for submarine berthing, dressing, lounge, messing, medical, dental, office and control spaces should adhere to the following specifications: dry-bulb 79 F, wet-bulb 59 F, relative humidity 50% and WBGT Index 63 F.

(5) With the exception of the above noted living and control spaces and areas containing engineering propulsion components, inside working spaces should be maintained at approximately the given temperatures for purposes of efficiency and comfort of personnel. In those cases where atmospheric heating and cooling needs of the individual cannot be met there is the added problem of adding or removing protective clothing; all normally worn clothing must be viewed as protective in nature when considering the potential hazards aboard ships and ashore.

3-5. Ventilation

(1) The purpose of ventilation is to remove toxic substances, offensive odors and excessive heat and moisture, and to provide an adequate oxygen supply. Naval ventilation should be designed not only to prevent conditions aboard ship which could lead to acute overheating, but also to maintain an atmosphere conducive to the physical and mental efficiency of personnel. Ventilation of work spaces must be adequate to control toxic substances such as; solvents (e.g., perchloroethylene in dry cleaning plants, PD-680 Type II as a degreaser, etc.), fuel combustion gases (e.g., “stack gas” in firerooms), fuel vapors (e.g., fuel pump rooms, firerooms, auxiliary machinery rooms), hydrogen sulfide in CHT pump rooms, etc. *Ships with conventional ventilation system shall have the capability to electrically secure ventilation to prevent ingestion or spread of NBC contamination within the ships.* In 1983 Navy policy was established that the Circle William material condition must not be set for longer than 5 minutes in machinery spaces during training evolutions. The ventilation systems in ships with Collective Protection Systems (CPS) shall provide clean, filtered air within the CPS zones.

Ventilation systems must be as flexible as those designed for heating. Hot weather cooling of given spaces by ventilation should be planned so that the temperature within those spaces will remain below specified limits. These limits are determined, using as a base the highest anticipated hot weather (outside) temperatures. For general planning purposes the design weather conditions are 90 F DB, 81 F WB and 85 F sea water temperature. Special considerations must be made for external ambient environmental conditions in the Persian Gulf; these design weather conditions are: 105 F DB, 95 F WB and up to 90 F sea water temperature.

(2) Air circulation within manned compartments must be sufficient to eliminate “dead spaces”. An adequate air exchange will insure the removal of odors and will prevent the accumulation of moisture on surfaces of the spaces. Ventilation exhaust from sanitary spaces, food preparation and dining areas, sculleries and garbage disposal areas must not be recirculated or introduced into any other spaces. Ventilation of food preparation, laundry, dry cleaning and propulsion spaces must be balanced to provide a *negative* pressure within those areas, i.e., allowing for a net flow of air into the spaces. Propulsion spaces should have exhaust at 115070 of supply air in 600 pound per square inch (psi), gas turbine and diesel propulsion plants and aircraft carrier machinery spaces; exhaust 125% of supply in all other 1200 psi propulsion plants.

(3) Cooling by *ventilation is* a process of diluting

inside air with cooler outside air. It has proved to be of value aboard ships in reducing excessive temperatures in manned spaces. In those cases where steam and water leaks are minimal, negative pressure ventilation may partially offset the *adverse impact of high temperatures* upon personnel. However, as the ventilation systems of ships deteriorate it is unlikely that ventilation alone will compensate for the increased environmental heat upon personnel. To achieve optimal exhaust ventilation in machinery spaces the size of the screens over the exhaust uptake ducts should be 1½ inch grid mesh, and the ventilation systems must be maintained at optimal capability. In other spaces within a ship the exhaust uptake ducts of nine inches or less across should have ½ inch grid mesh; if the exhaust uptake ducts are greater than nine inches across the screening must be 1½ inch grid mesh. It should be evident that usually it will not be possible to cool spaces to needed temperatures by ventilation alone; although this is the general practice in engineering machinery spaces.

3-6. Mechanical Cooling

(1) Mechanical cooling and dehumidification of air is accomplished by passing incoming air over coils and fins cooled with a suitable refrigerant. As the warm humid air circulates over the coils, it loses heat and the moisture condenses on the fins. The conditioned air is then circulated through a ducting system to appropriate spaces and compartments. Cooling coils may be located in an air supply duct with the refrigerating unit and fan placed remotely, or the entire apparatus may be assembled into a single unit.

(2) Air-conditioning is frequently required in spaces containing precision instruments which are sensitive to extremes of temperature and humidity. Appropriate filtering of air will assure air purity within tolerance limits for equipments and personnel working in the spaces.

(3) Mechanical cooling is a current feature of the living areas and office spaces of combatant ships and most auxiliaries. Basic medical areas are air-conditioned; this is done to improve the recovery of patients, which takes precedence over the customary space and weight limitations aboard ships.

(4) "Cold shock" may be produced when personnel pass from heated areas into air-conditioned spaces. Individuals experience a rapid loss of body heat due to an increased evaporation of sweat from wet skin and damp clothing. Chilly sensations and shivering are common manifestations. A corollary is seen in persons who move into outdoor heat from excessively cooled environments. Personnel in this situation experience sudden dilation of superficial blood vessels and flushing. "Cold shock" and its thermal counterpart may be minimized by regulating air-conditioned spaces so that the differential temperature between those areas and heated or outdoor environments does not exceed 15 F DB. Medical personnel should be alert to the occurrence of these phenomena in individuals who work in the daytime heat of natural environments or the high temperatures of engine rooms, firerooms, galleys, laundries, etc. Persons entering cold rooms (e.g., walk-in freezers, cold storage boxes, cold test chambers, etc.) need protection from "cold shock"; protection can be achieved by the temporary use of suitable clothing or limiting the frequency and duration of exposures. (Also see NAVMED P-5052-29)

3-7. Additional Considerations Aboard Ship

(1) Excessive moisture may be generated in multiple shipboard conditions. In firerooms and engine rooms steam and water leaks are common sources of increased water vapor. Inadequate steam exhausting from dishwashers creates a high moisture content in sculleries and in the air of passageways adjacent to sculleries. Water vapor in the air is increased by the evaporation of sweat from the human body. Individuals performing heavy work in a warm to hot environment may lose as much as 1.5 liter (1.6 quarts) per hour in evaporated sweat. More sedentary personnel may lose 0.2 liters (200 ml., 0.2 quarts) of sweat per hour in hot spaces. Air-conditioning and dehumidification are the only effective ways to sufficiently adjust the ambient moisture content of living and working spaces; cooling by ventilation alone results in humidity that is always above that of outside air.

(2) Mechanical air supply and exhaust systems are provided for most working and living spaces; the quantity for each should be balanced respectively within the major sections of a ship. Ventilation of spaces in which excessive heat or undesirable odors are produced (firerooms, engine rooms, galleys, laundries, heads, etc.) requires a special design in order to provide a greater volume of mechanical *exhaust* than supply *(negative pressure);* this maintains an induced air flow *into* the compartment and prevents the spread of heat and odors to adjacent spaces. Compartments used for living, berthing, etc., should be provided with a greater volume of mechanical *supply* than exhaust *(positive pressure)* in order to maintain an induced air flow *out* of the space and thus prevent the entrance of possibly contaminated air from adjacent spaces.

(3) Ventilation and air-conditioning designs for living compartments, recreation spaces, mess decks (excluding serving lines), sick bay and inpatient wards, operating rooms and intensive care spaces, administrative areas, control, and all operating electronic spaces aboard surface vessels encountering the hot-weather outside temperatures of 90 F DB and 81 F WB (design limits, Article 3-5) or higher should favor conditions that optimize recovery from heat stress and maximize performance in hot and subtropical climates. The upper thermal design limits within the above noted spaces should be 80 F DB, 68 F WB, 55% RH (14.3 Torr VP), with 72 F WBGT (as ET). For comparable spaces aboard submarines the design limits should be slightly lower in terms of moisture content of the air; 80 F DB, 67 F WB, 50% RH, with 71 F WBGT (as ET).

(4) A preferred WBGT temperature of 78 F applies to prescribed hot-weather operational conditions in: laun-

dries, galleys, sculleries, passageways not open directly on weather decks, and food serving lines. However, the upper thermal physiology shipboard heat stress design environments should not exceed that given in Table 3-1. Aboard submarines the overall demands within the vessel should preclude the environmental conditions reaching 78 F WBGT during normal operations.

(5) Fireroom and engine room spaces require a special application of the method of cooling spaces with outside air. Frequently so much "wild heat" is produced and uncontrolled that it is neither practical nor feasible to reduce the temperatures within the *entire* space to the point of maintaining high physiological efficiency without unique engineering techniques. Some ships have control booths in the propulsion spaces, the recirculating air-conditioning units for these booths need to be designed to permit ready access for frequent cleaning. Outside of the control booths, and aboard those ships without control booths, personnel must have immediate access to spot cooling. Spot cooling is effected by delivering outside air at high velocity via ventilation ducts to the respective watchstander's stations. By this method a "cone" of air is provided to watchstanders, even though the Effective Temperature outside the "cone" of air is very high.

Misconceptions have evolved regarding spot cooling, it has been widely believed: (1) that air velocities of 2,000 fpm or more at a supply terminal provides *optimal* spot cooling; (2) that increasing the volume of air flow through a fireroom or engine room will automatically reduce the level of heat stress at watch stations; and, (3) that in a very hot space the watch standers will be kept cool by putting their heads up to or just inside a supply terminal. In reality, the key element in spot cooling is not high velocities of air flow at the supply terminal but an *optimal effective air velocity flowing over the worker.* This can be best accomplished by positioning the supply terminal so as to assure a direct, unobstructed air stream at an equitable distance from the individual.

Figure 3-2 illustrates the relationship of air flow over workers versus the *Percent Optimum Cooling* achieved by the air flow. It can be seen that approximately 72% optimum cooling is achieved at 250 fpm air movement, 82% at 500 fpm, 90% at 750 fpm and 100% at approximately 1500 fpm; air flows over the worker which exceed 1500 fpm result in a rapid decrease in the percent optimum cooling of the worker in a hot-humid environment. The very high air velocities cause turbulence and friction at exposed skin surfaces, which in turn, leads to heating of the skin and drying of the eyes and respiratory membranes. Unless the increased air flow is needed for engineering purposes, it is uneconomical to increase the air flow six-fold (from 250 to 1500 fpm) to obtain the remaining 28% optimum cooling. Furthermore, when air velocities over workers are 2,000 fpm or higher the percent optimum cooling will have dropped to 36% or less. The reason that percent optimum cooling is essentially O% at 47 fpm air flow is due to the natural "chimney effect" associated with standing man.

(6) Radiant heat control is essential relative to the worker. In the design of shipboard spaces which have radiant heat sources it is necessary to insulate the radiating surfaces wherever possible. In those situations where metal surfaces cannot be insulated, they should be painted with a low emissivity paint (emissivity less than 0.4). Thermal insulation should have the lowest possible thermal conductivity (k) value. The insulating material should be well-fitted together, should be of proper thickness for the source temperature, should be kept intact, and protected by metal sheathing where high traffic and abuse may occur. A reflective aluminized outside surface of thermal insulation pads will reduce radiant heat transfer into the space. In all cases, thermal insulation should be kept dry to remain effective; which requires that steam and water leaks must be eliminated. Merely reinsulating radiating surfaces without first correcting the steam and water leaks leads to frequent replacement of insulation.

Commercial industry statistical data, from multiple samplings, show that the lowest k values for given densities of thermal insulation are achieved with ceramic *(refractory)* fiber insulation, as compared with fiberglass. Commercially available ceramic fiber at 8 pounds per cubic foot density has a lower k value than fiberglass insulation at 11 pounds per cubic foot density; where both insulating materials are of equal thickness. The lower the k value results in lower surface temperature and lower radiant heat transfer, furthermore, the ce-

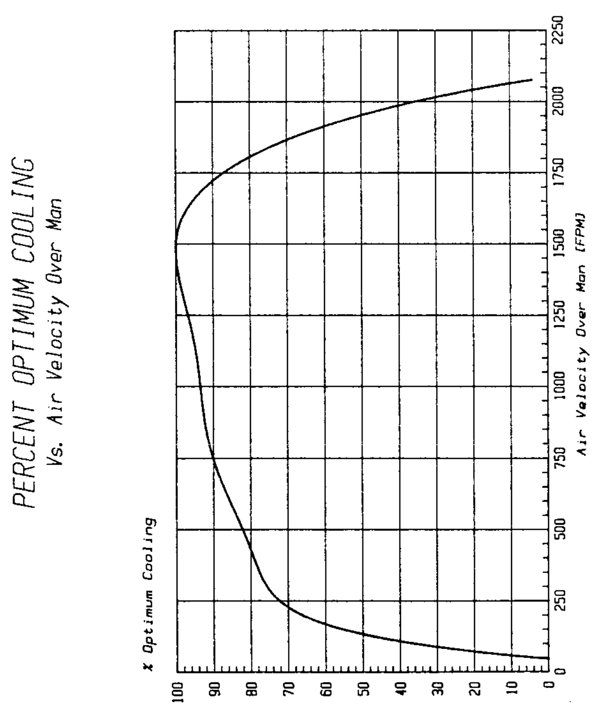


Figure 3-2.

ramic fiber insulation is lighter by approximately 3 pounds per cubic foot. Until recently, the use of ceramic fiber insulation aboard Navy ships was only permitted at temperatures above 850 F. Military Standards MIL-I-23 128 and MIL-STD-769 were revised, 1982 and 1983 respectively, to permit use of ceramic fiber insulation on machinery and piping surfaces below 850 F. At the present time, all airborne thermal insulation materials should be considered as potentially health hazardous.

(7) For many years the design of firerooms and engine rooms was based on equipment failure due to overheating and the potential of heat transfer of excessive heat to adjacent compartments. It was believed that workers could adapt or become "acclimatized" to the high levels of heat. *These concepts have been proven erroneous; the limiting factor is the worker not the equipment.* The physiological capability of workers cannot be altered to tolerate excessively hot-humid and hot-dry shipboard spaces, therefore, it is essential to design such spaces to permit personnel to perform their watch standing and equipment maintenance safely. Table 3-1 is the Thermal Physiology Design Criteria based on advanced, integrated technology. Allowances must be made for sufficient thermal recovery periods in thermal conditions similar to that noted in Article 3-7(3). Even with the exposure and recovery thermal design criteria given herein, mental impairment of workers maybe detectable after the first third of the respective exposure times. The environmental conditions for recovery must permit at least 6 hours of uninterrupted sleep per 24 hours. The thermal design limits given in Table 3-1 apply to *acute (short term) exposures only. No* definitive information exists at this time relative to the physiological effects of long term (repetitive exposures over a number of years) exposures in hot-humid shipboard spaces; however, one can assume that repeatedly exceeding the physiological limits of man is not conducive to the long term physiological well-being of the worker. (See Article 3-12.(8) regarding exceeding the PHEL values)

(8) The need for keeping the ventilation systems clean cannot be overemphasized. It has been estimated that a large naval vessel may take in as much as several tons of dirt a day into its ventilation system. Most of this is composed of fine, particulate matter which passes through filters but accumulate within ducting in high moisture environments. A significant amount accumulates on the filters, screens, heaters, fans and cooling coils and thus reduces the system's capacity for delivering the rated quantity of air. In order to obtain the maximum ventilation from existing equipment, all ventilation equipment should be cleaned and maintained on an established schedule. Use of a single layer of "cheese-cloth" may be used such as in galleys and laundries provided the cloth is changed frequently and dirt is not allowed to buildup. Maintenance of sufficient supply ventilation to control heat stress within a space should be given priority over the use of "cheese-cloth" over supply terminals.

Table 3-1. Summary of Thermal Physiology Heat Stress Design Conditions for Surface Vessels*

SPACE/LEVEL		Thermal Values At Actual Work Sites*			
		Dry-Bulb [F]	Wet-Bulb [F]	Globe [F]	Effective Velocity** [FPM]
PROPULSION SPACES: (NON-GAS TURBINE)					
Upper Level	4 Hrs	107	86	115	250
	6 Hrs	102	83	106	250
	8 Hrs	98	79	105	250
Lower Level	4 Hrs	98	84	108	250
	6 Hrs	92	81	100	250
	8 Hrs	89	78	96	250
PROPULSION SPACES: (GAS TURBINE)					
Upper Level	6 Hrs	98	85	100	250
	8 Hrs	93	82	97	250
Lower Level	6 Hrs	97	83	100	250
	8 Hrs	91	81	94	250
CATAPULT LAUNCH CONTROL ROOMS:					
	8 Hrs	92	80	97	250
LAUNDRIES:	4 Hrs	96	85	103	250
SCULLERIES:	3½ Hrs	92	83	94	250
GALLEYS:					
Food Prep. Area	4 Hrs	86	72	92	150
Food Serving Area	3 Hrs	86	77	94	150

*During normal work, excluding emergency or casualty control work rates. Environmental design conditions apply in work areas regardless of external ambient weather and sea water temperatures.

3-8. General Considerations Ashore

(1) Although the Navy has promulgated sound work practices for hot environments in its preventive medicine manuals for many years, they were directed primarily toward military personnel As a result of the Navy's Occupational Safety and Health (NAVOSH) Program, it is appropriate for the basic principles of heating, ventilation and cooling, contained in this chapter, to be applied to both military and civilian workers ashore and afloat. Implementing sound hot weather practices should be done in accordance with thermal conditions given in Table 3-2.

(2) The WBGT threshold values illustrated in Table 3-2 are needed for identification of heat stress levels at which *sound systemic heat injury preventive measures should be instituted.* They are based upon the hottest 2-hour period of a day ashore. The various preventive measures are given in Section III. *These threshold 2-hour exposure WBGT values must not be confused with the Physiological Heat Exposure Limits (PHEL) that apply to the exposure limits of workers in hot environments. WBGT threshold values apply to situations where sound preventive measures must be instituted; PHEL applies to safe physiological limits for exposures.* PHEL applications are discussed in detail in Section IV of this chapter.

Table 3-2. Recommended Threshold WBGT Values For Instituting Sound Hot Weather Practices

Work Load	Threshold 2-Hour Exposure WBGT (F)
Light Work (time-weighted-mean metabolic rate of 82 KcaI*m $^{-2}$*hr $^{-1}$)	86
Moderate Work (time-weighted-mean metabolic rate of 104 Kcal*m^{-2}*hr $^{-}$1)	82
Heavy Work (time-weighted-mean metabolic rate of 125 Kcal*m $^{-2}$*hr^{-1})	77

3-8. General Considerations Ashore

(1) Although the Navy has promulgated sound work practices for hot environments in its preventive medicine manuals for many years, they were directed primarily toward military personnel As a result of the Navy's Occupational Safety and Health (NAVOSH) Program, it is appropriate for the basic principles of heating, ventilation and cooling, contained in this chapter, to be applied to both military and civilian workers ashore and afloat. Implementing sound hot weather practices should be done in accordance with thermal conditions given in Table 3-2.

(2) The WBGT threshold values illustrated in Table 3-2 are needed for identification of heat stress levels at which *sound systemic heat injury preventive measures should be instituted.* They are based upon the hottest 2-hour period of a day ashore. The various preventive measures are given in Section III. *These threshold 2-hour exposure WBGT values must not be confused with the Physiological Heat Exposure Limits (PHEL) that apply to the exposure limits of workers in hot environments. WBGT threshold values apply to situations where sound preventive measures must be instituted; PHEL applies to safe physiological limits for exposures.* PHEL applications are discussed in detail in Section IV of this chapter.

Table 3-2. Recommended Threshold WBGT Values For Instituting Sound Hot Weather Practices

Work Load	Threshold 2-Hour Exposure WBGT (F)
Light Work (time-weighted-mean metabolic rate of 82 KcaI*m $^{-2}$*hr $^{-1}$)	86
Moderate Work (time-weighted-mean metabolic rate of 104 Kcal*m^{-2}*hr $^{-}$1)	82
Heavy Work (time-weighted-mean metabolic rate of 125 Kcal*m $^{-2}$*hr^{-1})	77

Section III. PHYSIOLOGICAL PRINCIPLES

3-9. Effects of Heat

(1) *General Effects.* Heat stress and heat strain have both immediate and long-term effects on humans. The immediate effects are a significant loss of performance, efficiency and loss of duty time due to systemic heat injury. Generally, the long-term effects of heat stress and strain arc not as apparent as the immediate effects. Prolonged exposure, however, is viewed as contributing to:

(a) Progressive loss of performance capability.

(b) Increased susceptibility to other forms of stress.

(c) Reduced heat tolerance.

(d) Potentially increased physical disability compensation.

(2) *Heat Balance Equation.* In order to understand the interaction between man and a heat stress environment, it is necessary to examine the concept of the empirical "Heat Balance Equation;" which is given as:

$$M \pm R \pm C - E = S$$

where; M = metabolic rate or heat production of man
R = radiative heat gain to or loss from man
C = convective and conductive heat gain to or loss from man
E = evaporative cooling
S = heat storage in man

Man's internal heat (M) is produced by basic metabolic function and heat of variable physical activity (work). In the "Heat Balance Equation" this factor (M) always results in a positive value; to be a living body the function of metabolism must occur, therefore, heat will be produced. Heat transfer by radiation (R), convection and conduction (C) between man and its environment may result in a positive or negative heat balance. For example, if the environment is cooler than man a *negative* (toward the environment) *heat balance will* result. Conversely, when the environment is warmer than the subject, a *positive heat balance* (toward the subject) results. If uncompensated, this latter state results in excessive heat storage and leads to the various physiological states we recognize as "heat strain". Loss of body heat by evaporation (E) is the fourth means by which man is able to maintain thermal equilibrium. Evaporation by sensitive and insensitive perspiration results in cooling of the body surface. Evaporation does not occur when the partial vapor pressure of water in the environment equals that of the body surface. Further, if the partial vapor pressure of water in the environment exceeds that of the skin, environmental moisture condenses on the skin with a resultant positive conductive heat transfer by no evaporation. Evaporative heat loss from the respiratory mucosal surfaces is minimal, representing perhaps only 2070 of the matabolic heat (M).

(3) *Thermoregulatory Mechanisms.* Body heat is regulated by a complex interactions of physical environmental factors (temperature, humidity, air movement, radiant heat, etc.) and the physiologic and behavioral response of the subject. The skin surface is the primary

site of heat exchange between the body anti the surrounding environment. Thermoregulation is mediated by circulatory (e.g., central and capillary blood flow), neural (e.g., hypothalamic, autonomic pathways), and biochemical (e.g., ionic and endocrine) functions involving central or peripheral levels of response and by individual behavioral variants. If man is to compensate for environmental heat stress, this intricate physiologic network must remain functionally intact. The degree and reversibility of heat strain in any given case is directly related to the duration and severity of the disturbance of mechanisms for heat regulation.

(4) ***Failure of Thermoregulation.*** When temperature balance mechanisms for the body fail, spiraling of body temperature is initiated. Heat storage increases; skin and deep-tissue temperatures rise; cardiovascular, respiratory and metabolic functions accelerate; and, renal function is depressed. Increased metabolic heat pushes the cycle faster to the point of cardiovascular and renal failure and irreversible damage to the nervous system and muscular tissues. The cycle can be broken only by timely and definitive therapy.

(5) ***Acclimatization.*** Physiologic response to heat stress has been treated thus far as a rapidly occurring process with decompensation resulting in relatively immediate damage or in cumulative injury over a more prolonged time period. ***Under more favorable thermal conditions,*** the body can "acclimatize" or adapt to environmental heat stress. Until 1971 it was accepted that acclimatization to heat stress could be descriptively characterized by near normalization of heart rate and skin and rectal temperatures during 4 to 6 days of successive heat exposure. In addition, sweat production during adaptation was expected to increase to levels of 1.5 or more liters per hour. In 1971 Navy medical researchers indicated that these parameters were inadequate to describe acclimatization accurately; the research indicated the earlier studies were premature in the assessment of heat acclimatization on consecutive days, as a number of other physiological parameters had not reached an adapted state. Using both untrained and trained test subjects, the studies extended exposures out to 90 days. It was learned that heat acclimatization was only 78% complete after 14 consecutive days of work in hot-humid heat.

Application of advanced criteria for optimum heat acclimatization revealed, when personnel were previously trained to perform moderate physical work without physiological strain in a thermally neutral environment, that various body systems adapt at different rates. Table 3-3 illustrates the percent achievement of optimum heat acclimatization for 13 physiological parameters at 4 time intervals of consecutive days exposure while performing moderate physical work. Overall optimum heat acclimatization to hot-humid conditions of 95 F DB, 88 F WB and air movement of 100 fpm was achieved in 22 consecutive days of heat-work exposures.

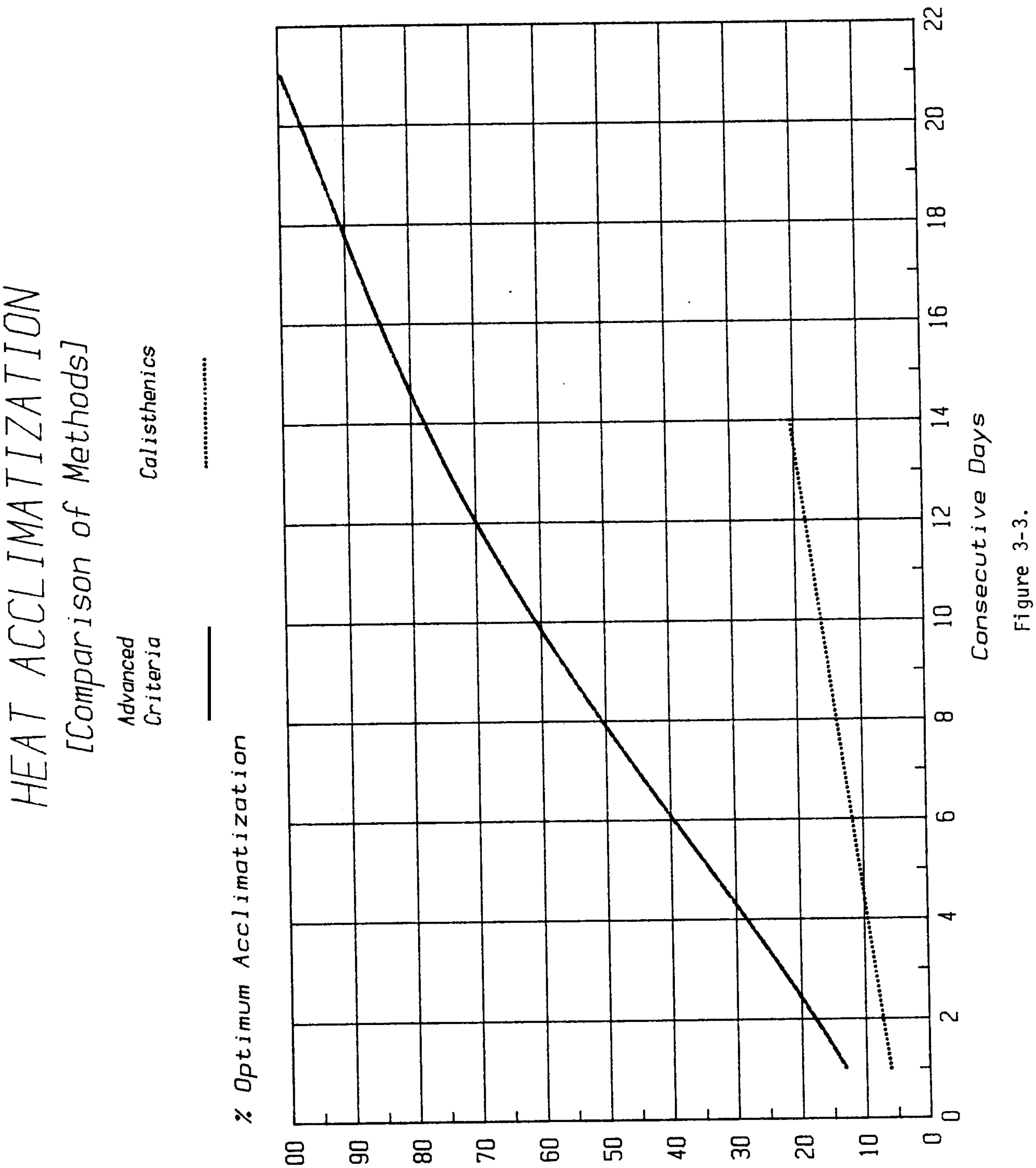
As can be seen in Figure 3-3, the rationale prior to 1971 overestimated how much heat acclimatization could be achieved in time periods as short as one week. In 1976 the findings of the Navy medical researchers were borne out by a research team in South Africa, who comprehensively studied energy exchanges, body temperatures, sweating, cardiovascular adjustments, body fluid adjustments, body weight deficits and circulating protein changes. Clearly, there are 3 distinct stages of acclimatization, of which the third stage begins after the seventh consecutive day of inducing heat acclimatization.

Special consideration must be given to various other factors. Heat acclimatization is not applicable to overall heat stress levels indicated in Table 3–2; thus, personnel working in areas such as firerooms, engine rooms, laundries and steam catapult launch control rooms should not be expected to adapt physiologically to their environment. In order to achieve maximum benefits from acclimatization, *it is extremely important that moderate (more than sedentary) work be performed during the adaptation process.* Even fully acclimatized personnel are rendered more susceptible to heat injury in the event of excessive fatigue; alcoholic intoxication; acute infectious disease; obesity; inadequate water, salt or caloric balance; and the use of medications containing belladonna alkaloids. The rate of achievement of heat acclimatization is *retarded by the use of commercially prepared electrolyte-type beverages as well as supplementary sodium chloride ("salt"] in excess of* 2

Table 3-3. Percent Optimum Heat Acclimatization on Consecutive Days of Heat-Work Exposures for Physically Trained Personnel

Physiologic Parameter	Percent Achievement On:			
	Day 1	Day **7**	Day 14	Day 21
Rectal Temperature	6	38	**72**	100
Tympanic Membrane Temperature	6	37	**71**	100
Deep Esophageal Temperature	51	82	**93**	100
Mean Skin Temperature	80	93	**98**	100
Heart Rate	8	37	**67**	100
Systolic Blood Pressure	11	38	**56**	100
Diastolic Blood Pressure	7	36	**70**	100
Pulse Pressure	9	36	**63**	100
Mean Arterial Blood Pressure	4	35	**79**	100
Est. Total Vascular Resistance	8	37	**70**	100
Est. Cardiovascular Reserve	7	36	**69**	100
Sweat Rate	3	37	**76**	100
Urine Osmolality	3	39	**82**	98
Overall Percent Achievement	13	**45**	78	**99.6**

Figure 3-3.—Heat Acclimatization (Comparison of Methods).



grams per day, this is discussed in more detail in this section. Finally, a degree of stable acclimatization at any one level of heat stress does not guarantee full acclimatization to a higher level of heat stress.

(6) ***Heat Illnesses.*** There are various reasons why military populations are more prone to heat disorders. The constant influx of unseasoned and unacclimatized personnel into recruit training creates a potential for an increased incidence of heat illnesses. Following recruit training, exposure to a variety of environmental stresses can be expected, with little opportunity for prior adaptation. In combat situations, with mass movements of military units to tropical and desert climates, well trained personnel may be exposed to a higher level of heat stress. A common-sense preventive measure program, emphasizing moderate physical activity and general health maintenance, will lead to the early adaptation of physically fit personnel to the more stressful environment. Heat disorders have a world-wide distribution and may even occur in cold climates where metabolic heat production exceeds an individual's adaptive abilities. They may, in severe cases, be accompanied by changes in serum electrolytes (hyponatremia, hypochloremia, acidosis, hyperkalemia), urinary electrolyte concentrations (decreased sodium and chloride excretion, increased loss of potassium and hydrogen ions), proteinuria, increased consumption of protein, and coagulopathy (disseminated intravascular coagulation defects). Acute overheating may thus lead to numerous heat related illnesses. In order to describe expeditiously these diseases and their management, they have been consolidated into 4 basic categories, excluding local heat injury due to burns: (1) heat rash, (2) heat cramps, (3) heat exhaustion (including anhidrosis, salt-deficiency, water-deficiency, exercise-related heat exhaustion and heat syncope, and (4) heat stroke (including hyperpyrexia).

(a) ***Heat Rash.*** The clinical picture of heat rash (miliaria rubra) is too well-known to require description. It is prevalent among military populations living in hot climates or working in hot spaces ashore or aboard ship. It interferes with sleep, resulting in decreased efficiency and cumulative fatigue, and thus, predisposes the individual to heat exhaustion. Heat rash impairs sweating and decreases evaporative cooling on the skin surface; it may, therefore, favor the evolution of heat stroke.

(b) ***Heat Cramps.*** Heat cramps may occur as an isolated syndrome with normal body temperature or in conjunction with heat exhaustion. They are precipitated by the replacement of body water losses without concurrent replacement of sodium chloride deficits. Heavily sweating individuals drinking large volumes of water with insufficient salt replacement are particularly at risk. Heat cramps may be localized or generalized with recently stressed muscle groups, particularly those of the extremities and abdominal wall are most frequently involved. Minimal serum and urinary electrolyte changes, as well as hemoconcentration, may be observed but should not be expected. Clinically the patient usually exhibits moist, cool skin and normal or slightly elevated temperature. Muscular soreness (myalgia), a normal finding following heat cramps, must be differentiated from that occurring in association with rhabdomyolysis which is associated with necrosis of muscle tissue. Whereas salt depletion appears to be instrumental in the evolution of heat cramps, *"salt loading"* may be contributory in the pathogenesis of rhabdomyolysis. Therefore, until definitive evidence is available, *"salt loading"* should be avoided in the prevention and therapy of heat cramps.

(c) ***Heat Exhaustion***

(1) Heat exhaustion occurs as the result of peripheral vascular collapse due to excessive dehydration and salt depletion, however, the usual case involves dehydration and over-exertion during physical work. The syndrome is characterized by profuse sweating, headache, tingling sensations in extremities, pallor, dyspnea, palpitations associated with gastrointestinal symptoms of anorexia, and, occasionally nausea and vomiting. Neuromuscular disturbances with trembling, weakness, and incoordination coupled with cerebral signs ranging from slight clouding of the sensorium to actual loss of consciousness complete the picture. Heat cramps may be present. Physical examination reveals a mild to severe peripheral circulatory collapse with a pale, moist, cool skin and a rapid (120-200 beats per minute at rest), thready pulse. Systolic blood pressure will generally have been quite elevated (180 mm Hg or higher during work) prior to the onset of the illness, followed by a rapid drop while work continued, and within normal range by the time of examination; however, the wide ***pulse pressure*** during work will usually be decreased at the time of physical examination. The oral temperature may be subnormal (as in the case of hyperventilation being present) or slightly elevated. It is not uncommon to find rectal temperatures of heat exhaustion patients between 101-104 F, dependent upon the type and duration of physical activity prior to the overt illness.

(2) Heat exhaustion is an accepted clinical diagnosis and, as a classification of heat disorder, it constitutes the majority of reported cases of heat illnesses. However, from the standpoint of pathogenesis, heat exhaustion is not one but several entities. *Exhaustion or collapse in the heat can occur from physical work alone, even in the absence of dehydration or salt deficiency.* Nevertheless, in some cases, more frequently in unacclimatized personnel, water or salt deficiency is present to some degree and may be primarily responsible for the clinical picture. Once again the problem of body salt content arises. Figure 3-4 illustrates numerous interacting factors predisposing heat cramps, heat exhaustion, heat stroke and rhabdomyolysis (noted under "Heat Cramps"). Unless salt deficiency has been *clearly demonstrated by laboratory analysis* of serum or urine, one should be suspicious of *salt loading* if a reasonably normal diet has been maintained and supplementary salt has been taken indiscriminately. Prior to 1972 there were numerous reports indicating heat exhaustion patients having consumed between 6-24 salt tablets per 24 hours,

even when eating a well balanced diet. Since 1972 the Navy Medical Department placed use of salt tablets on a controlled basis, the high consumption of sodium chloride has been primarily limited to eating field rations without sufficient water intake (See "Salt and Water Intake" in Article (8)(b)(2) of this Section). All patients suffering an episode of severe heat exhaustion should be assigned light duty for 24-48 hours following their initial recovery. Should a patient experience additional bouts of heat exhaustion, a careful review of the medical history and working situation should be undertaken and corrective actions instituted. *Strong consideration should be given to personnel being more susceptible to recurrence of heat exhaustion or possibly heat stroke.* Recurrence of serious disorders are usually more severe than the preceding bout. It is believed that the susceptibility lasts, which requires affected personnel to be reintroduced into the work situations in gradual steps to determine their safe limitations. Documentation of the heat illness should be included in the individual's health record, details should be provided to guide followups or a clear history for future reviews.

(3) ***Heat Syncope*** is a familiar form of heat illness, not related to salt or water deficiency or to excessive physical work. This type of heat illness is typically seen in troops standing in parade formation in hot outdoor climates. It is the result of pooling of blood in dependent parts of the body and dilation of peripheral vessels. The disparity between vascular capacity and circulating blood volume leads to cerebral ischemia. Vagotonia may be a contributing factor.

PATHOGENESIS OF COMPLICATIONS OF EXCESSIVE PHYSICAL EXERCISE

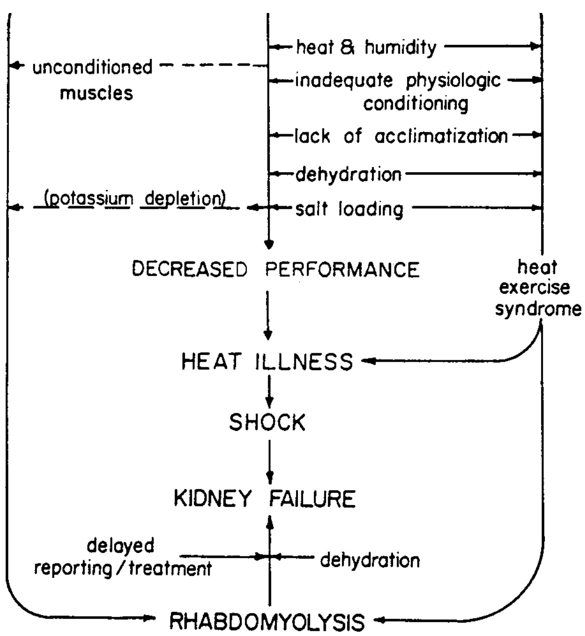


Figure 3-4.

(4) ***Anhidrotic Heat Exhaustion*** maybe the result of a preexisting dermatologic lesion (usually heat rash or sunburn) which interferes with sweat secretion. Personnel may not be aware of progressive heat intolerance associated with impairment or absence of sweating. Salt and water deficiencies are not prominent in this form of heat illness. Clinical examination reveals a warm, dry skin and an elevated deep body temperature, sometimes as high as 104–106 F. Exhaustion is present, but disturbance of consciousness is uncommon in the early stages of the disorder. ***Some*** individuals with the disorder may develop true heat stroke.

(5) When prompt first-aid is available, the mortality rate from heat exhaustion syndromes is extremely low. As a rule, removal of the victim from a hot environment to a cool area, rest and fluid replacement when indicated will satisfy the needs of all but the most severe cases of this disorder.

(d) ***Heat Stroke*** — HEAT STROKE IS A MEDICAL EMERGENCY and is associated with a potentially high mortality rate. Whereas *heat exhaustion* may be regarded as the end result of overactive heat-balance mechanisms which are still functioning, *heat stroke* results when thermoregulatory mechanisms are *not functional,* and the main avenue of heat loss (evaporation of sweat) is blocked. There may be prodromal symptoms of headache, malaise and excessive warmth, or a general picture of heat exhaustion. The onset is usually abrupt with sudden loss of consciousness, convulsions, or delirium. Sweating may or may not be absent in the typical case. Inquiry may reveal that the cessation of sweating was noted by the patient prior to onset of the other symptoms, however, with marked central nervous system (CNS) involvement (e. g., unconsciousness) this information usually comes too late. Since water intake may continue in the absence or reduction of sweating, overhydration rather than dehydration may occur. This is manifested by diuresis which is an added signal of impending disaster. During the early stages of this condition, after the body temperature has risen, the patient may exhibit euphoria. On physical examination the skin is hot, flushed and dry; in severe cases petechiae may be present. Deep body temperature is high, frequently in excess of 106 F. A rectal temperature exceeding 108 F is not uncommon and indicates a poor prognosis. The pulse is full and rapid, while the systolic blood pressure may be normal or elevated and the diastolic pressure may be markedly depressed (60 mm Hg or lower). Respirations are rapid and deep and simulate Kussmaul breathing. As the patient's condition worsens, cyanosis is usually noted together with a peripheral vascular collapse manifested by a rapid pulse and hypotension. The breathing becomes shallow and irregular. Pulmonary edema, incontinence, vomiting, hemorrhagic tendencies, disturbance of muscle tone, myocardial necrosis, menigismus, opisthotonos, jaundice, albuminuria, thrombocytopenia and prolongation of the prothrombin time may occur. Renal failure with rapidly developing hyperkalemia and azotemia is not uncommon. Death may ensue very rapidly, but if the patient survives until the second day, recovery chances improve. Rectal temperatures of 102-103 F may persist for several days during which time mental disturbances, excitement and delirium may continue or recur. Headache may persist for several weeks after the attack. In the first few days after the temperature has been reduced from a critical level severe relapses may occur. The patient should, therefore, be observed carefully during this period and rectal temperatures should be recorded frequently. Treatment, as outlined below, should be started again at the first indication of relapse. It is also important to emphasize that the heat regulating centers may be extremely labile for many weeks after an attack. One attack of heat stroke predisposes to a second attack, and care should be taken by the individual to avoid a second exposure to the precipitating condition. An alternative view is that the individual is a member of a susceptible population and remains susceptible. Careful documentation of all factors associated with the occurrence and treatment of this illness are essential.

(7) ***Treatment of Heat Casualties***

(a) ***Heat rash*** is best treated by keeping the skin dry for part of the day at least. Cooled sleeping quarters will remedy the situation and permit personnel to work in hot-humid conditions without developing heat rash. Calamine *lotion* may be useful under appropriate environmental conditions. When the environment or physiological climate does not permit the skin to remain dry for more than a few minutes a day, calamine *liniment* may offer some relief.

(b) ***Heat cramps*** are initially treated by relieving the severe pain and evaluating serum/urine chemistries for evidence of salt depletion. If such a deficiency exists, the administration of O. 1% or physiologic saline solution by mouth or physiological saline intravenously may be indicated. Care should be taken not to give excessive amounts.

(c) ***Heat exhaustion*** generally requires only rest in a cool place and adequate water intake. As in the case of heat cramps, saline solutions are indicated only when salt depletion has been documented in the laboratory. When physical exertion preceded the onset of heat exhaustion, and a salt deficiency exists, the judicious intravenous administration of physiologic saline or 5% glucose and saline may accelerate recovery. Recovery is usually prompt, but *immediate return to duty is inadvisable except in the mildest cases.*

(d) Anhidrotic heat exhaustion must be treated as if it is heat stroke. Prompt intervention is essential. Until the normal skin function can be restored the patient should not return to the environmental situation which precipitated the illness.

(e) Heat stroke is a MEDICAL EMERGENCY. Treatment principles are outlined below:

(1) ***Restore Normal Temperature.*** The body temperature must be lowered *promptly* to safe levels (rectal temperature 100-101 F). The more prolonged the hyperpyrexia, the greater is the threat to life; the hyperthermia accelerates metabolic heat production, causing the body temperature to spiral upward at an ever-increasing rate. In the field, the patient's clothing should be removed, except for underwear. If there is a source of cool water nearby, the patient should be immersed in it—otherwise water should be sprinkled over the patient and its evaporation hastened by fanning. In addition to these cooling measures, attendants should rub the victim's extremities and trunk briskly to increase the circulation to the skin. Arrangements should be made for the immediate removal of the individual to a hospital or properly equipped treatment facility; cooling measures should be continued during the transfer. Upon reaching the medical facility, the patient should be placed in a tub of water and ice. W bile in the ice-water the extremities should be massaged continuously as noted above. When the rectal temperature drops to between 100-101 F, the victim may be removed to a hospital bed. The rectal temperature should be monitored every 10 minutes until stable. Within the first few days of hospital treatment there should be careful observation for a relapse; the patient may readily become hyperthermic or *hypothermic.* It is desirable to maintain the rectal temperature between 100-101 F. Rapidly increasing temperatures can usually be managed with ice water sponge baths and fanning; precipitous drops in temperature may require the judicious use of warm blankets. Shivering, involuntary muscular activity, is undesirable because it accentuates tissue hypoxia and lactic acid acidosis. Again, the patient's rectal temperature should be monitored every 10 minutes during a hyperthermic or hypothermic condition.

(2) ***Drugs:***

(a) ***Sedative Drugs.*** Sedative drugs should be avoided if possible since by their depressive effect they may disturb central thermoregulatory centers. Restlessness can usually be controlled with gentle restraint. Sedatives are indicated in the treatment of convulsions. If a longer acting drug is needed, pentobarbital should be administered intramuscularly. Sodium amytal and morphine are contraindicated.

(b) ***Other Drugs.*** Atropine or other drugs which may interfere with sweating are contraindicated. Ephinephrine and other adrenergic drugs should not be used. However, when hypotension occurs accompanied by low cardiac output (elevated central venous pressure, congestive heart failure) isoproterenol (or dopamine) can be effective in improving cardiovascular dynamics. Intravenous administration of mannitol to induce osmotic diuresis may be useful where renal tubular necrosis is suspected. The use of aspirin, or like medications, is not indicated, since there is no evidence that it will lower body temperature in the noninfectious state. *Small doses of diazepam* (Valium— 10 mg) *may be administered intravenously to control convulsions as needed.*

(3) Intravenous Fluids. Parenteral administration of physiological saline solution in moderate amounts (1,000-1,500 cc.) may be indicated. However, *extreme caution must be exercised if a hyperthermic state exists;*

in a hyperthermic state the patient may appear hypovolemic but would be normovolemic in a normothermic state. Subsequent fluid administration must be determined by hourly urinary output and serum electrolyte determinations. Plasma volume expanders should be administered with caution if there is evidence of shock, especially if the patient is reasonably normothermic; a rapid pulse, of small volume, is an indication for considering their use. Care should be taken in the administration of parenteral fluids if there are signs of pulmonary congestion or rising central venous pressure. Close observation of the patient for renal failure is necessary. Rapidly developing hyperkalemia and azotemia necessitates hemodialysis or peritoneal dialysis.

(4) ***Venesection.*** Venesection is ineffective in treating the pulmonary edema which occurs with heat stroke.

(5) ***Oxygen.*** Oxygen may be desirable to combat tissue anoxia. Oxygen should be administered by face mask or nasal catheter if cynosis or pulmonary congestion is present. The use of a nasal catheter rather than a face mask is recommended if the patient has been vomiting, because of the danger of aspiration from the face mask.

(6) ***Other Complications.*** Spontaneous hemorrhage may occur as the result of hypofibrinogenemia or consumptive coagulopathy. Renal failure, pulmonary congestion and cerebral edema may complicate the clinical course. Details of therapy are beyond the scope of this manual. Readers are referred to current texts and technical papers on this subject.

(7) ***Disposition.*** All episodes of heat stroke should be fully documented and made a part of the patient's permanent medical record. Evidence suggests that serious physiologic damage may persist long after apparent recovery from heat stroke. Heat stroke victims may thus be more susceptible to recurrent episodes of heat illness under less intense conditions. *Heat stroke victims never be returned to heat stress similar to that which precipitated the illness without the approval of an appropriate medical authority (Medical Board).* A personnel heat injury report ("Heat/Cold Injury Report", NAVMED 6500/1) should be submitted to Commander, Naval Medical Command, Attention MED 22, Department of the Navy, Washington, D. C., 20372.

(8) ***Prevention of Heat Injuries***

(a) ***Engineering Control:***

(1) Engineering measures begin with adequate isolation or insulation of the principal sources of heat and humidity. Sound engineering practice should be maximum reduction of steam and water leaks, proper ventilation and maximum control of radiant heat. In some situations the source should be completely enclosed and connected to an exhaust. Special industrial settings may not permit the general atmosphere to be cooled by ventilation or mechanical means, therefore, isolation of the workers from the sources of heat must be practiced. When only a few workers are exposed in a large space, control can be accomplished by spot cooling and use of clothing which is unstarched and has good wicking characteristics, or by use of loose-fitting coveralls through which cool air is circulated. The latter also requires an unrestrictive air supply which provides clean, filtered breathing air. The temperature of air striking a worker within the spot cooling cone should not be less than 80 F; for continuous exposure the velocity should be approximately 250 fpm (See Article 3-7). Short exposures to higher velocities, below those associated with skin friction (about 1500 fmp), are sometimes beneficial in partially offsetting the presence of low levels of radiant heat. Workers can adjust their exposure by moving in and out of the spot cooling cone. Flexible ducts provide a means to regulate the location of spot cooling, thus avoiding excessive chilling of the head, shoulders and back. Engineering practice, however, should include proper positioning of supply terminals so that maximal effective air velocities may be obtained.

(2) Control of radiant heat is essential, in terms of economy in operating the systems as well as the well-being of personnel. As indicated in Article 3-7(6), thermal insulation should be well-fitted, no gaps, should be of proper thickness for the source temperature, should be kept intact and protected by metal sheathing where high traffic of abuse may occur. Furthermore, multiple layers of paint reduce the effectiveness of thermal insulation in controlling radiant heat. Snow white paint has an emissivity of approximately 0.9, whereas some highly buffed or polished stainless steels (e.g., Type 18-8, Allegheny metal No. 4 or No. 66) have emissivities from 0.11-0.16. The lower the emissivity of the outer covering the better the control of radiant heat. However, it must be noted that applying thermal insulation *over a low emissivity surface (e.g.,* pipes painted with low emissivity paint) does not effectively control radiant heat transfer from the insulation surface. The exposed surface emissivity is the important aspect of radiant heat transfer. On bare, uninsulated metal the application of low emissivity paints (with emissivities of 0.4 or less) will assist in controlling radiant heat transfer to the space. Since the Navy undertook major replacement of asbestos thermal insulation with soft (fibrous) fiberglass there were many complaints that radiant heat increased abroad ships. Part of the problem is associated with the quality of workmanship, but one cannot overlook the thermal conductivity (k) factors, densities and thicknesses of fiberglass replacement material. The lower the k factor of thermal insulation the better the control of radiant heat. Ceramic has a lower k factor at 8 pounds per cubic foot density than the fiberglass at 11 pounds per cubic foot density. Therefore, given equal thicknesses of ceramic ("refractory") fiber insulation and fiberglass, the ceramic fiber insulation is superior in controlling radiant heat. It is essential that the quality of all thermal insulation materials must be checked to ensure that specific characteristics of the materials are actually received to meet system design criteria. When extreme radiant heat is present, personnel should be protected by use of reflective devices (e.g., clothing or screens) and protection of hands, face and eyes. Also whenever personnel handle asbestos, fiberglass or ce-

ramic insulation materials, they should be protected; in particular their respiratory systems should be protected. Asbestos and fiberglass have been proven to be deleterious to the health of human, and recently ceramic fibers have been shown to be deleterious to the health of animals.

(3) In very special situations the use of vortex cooling garments may be used, but the objective liabilities may outweigh the subjective false sense of well-being which they impart; furthermore, as in the case of ***compressed*** air cooling, the air must be free of all possible contaminants (e.g., same quality standard of air used for diving). Other important preventive measures include an adequate number of showers for the workers, clean rooms for changing into dry clothes after work and a thermal environment with the design characteristics noted in Articles 3-7(3), 3-13(6) and 3-13(7).

(b) ***Medical Measures.*** Engineering methods are not always effective and often must be supplemented or preceded by medical measures. In physiologically compensable environments, performance in the heat can be improved greatly by proper selection and acclimatization of workers. In all hot environments, improved performance can be achieved by controlling fatigue, nutrition and alcoholic usage, and by periodic examination for underlying illness and the early symptoms of heat strain. The reasons for different persons developing different forms of heat illness are not clear. Until such information becomes available, every effort should be made to relieve excessive stress on each individual's heat regulating mechanism. The following measures will assist in reducing systemic heat injuries:

(1) ***Acclimatization.*** Heat acclimatization applies to those environments which permit physiological compensation such as outdoors, or in those indoors situations which are not excessively hot; for excessively hot indoors environments see Article 3-9(8)(b)(6). Heat acclimatization can only be acquired satisfactorily by working in a compensable hot environment over a period of time (See Article 3-9(5)). *Rapid acclimatization in raw recruits is impossible except under close medical supervision;* even then, it may be difficult to avoid some heat casualties. A "break-in" period of about two weeks, with progressive degrees of heat exposure and physical exertion will minimize the number of systemic heat injuries and improve productivity over a longer time period.

(2) ***Salt and Water Intake.*** (Medical personnel will find detailed information on salt and water requirements in NAVMEDCOMINST 6260.6 series.)

(a) Indoctrination of supervisory personnel in recognizing the need for liberal allowance of water will help abolish the false notion that men can be trained to resist dehydration. "Water discipline" must be replaced with the doctrine of "water freedom" in which drinking moderate amounts of cooled water at frequent intervals is encouraged.

(b) Maintenance of a proper salt content is of greatest importance, particularly to individuals in the early stages of heat acclimatization. The rationale used for many years was that large quantities of salt were being lost in the sweat and that the body was unable to manage physiologic conservation of salt. Thus, it had been widely assumed that large quantities of supplementary salt were necessary, and that excessive amounts would be excreted without harmful effects. Unfortunately, many deleterious side effects were ignored for years. The potential relationship of rhabdomyolysis and excessive sale loading (Figure 3-4) lead to extensive investigation of the relative value of supplementary sodium chloride intake by healthy young men (ages 19-3 1) during training and heat acclimatization. It was determined that:

(1) The current estimated "normal" dietary intake of sodium chloride in the general United States population is approximately 15 gms daily. This estimate includes the common practice of salt shaker supplementation prior to tasting of served food.

(2) Field rations contain a variable amount of sodium chloride, dependent upon the Federal Stock Number and the manufacture dates. Individual Combat Meals (FSN 8970-577-4513) manufactured prior to 1975 contain 22.1 gms of salt for those eating 3 meals per day, without using the salt packets. Individual Combat Meals of the same stock number but manufactured as of 1975 contain 9.0 gms of sodium chloride for three meals per day, without using the salt packets. Long Range Patrol Food Packets (FSN 8970-926-9222) contain 25.5 gms of sodium chloride, without using the salt packets. Individual Ready-to-Eat Meals, replacing the Individual Combat Meals noted above, contain 19.9 gms of sodium chloride, without using salt packets. Each sodium chloride (salt) packet contains 4 gms of salt, and up to 3 packets are provided per day. Therefore, it is possible to have an intake of 37.5 gms of NaCl per day. The high salt content of field rations is basically to preserve the food for a longer storage life.

(3) An individual's greatest need would occur during the combined stresses of initial physical training and heat acclimatization in a hot-humid environment without water restriction. However, judicious use of sodium chloride is recommended.

(4) The field grade salt tablets are 10 grain (0.648 gins; 0.255 gms of sodium and 0.393 gms of chloride) each.

(c) The investigative results to date suggest that the free use of supplementary sodium chloride or salt tablets is contraindicated under most conditions of heat stress. *Proper sodium chloride level can be achieved by providing adequate water a normal diet and a salt shaker on the table for conservative use, with no more than the equivalent of 2.0 gms of supplementary salt (preferably not salt tablets) per day.* Deviations from these recommendations must be governed by the past and present medical histories of individual workers and adjusted according to individual need by the Medical Department representative. There is clear evidence that use of commercially prepared electrolyte-type beverages reduce physiologic performance. Furthermore, supplementary sodium chloride produces a 20% reduction of the optimal work capacity of personnel in the heat, reduces the rate of achievement of optimal heat acclimatization and alters cardiac function. There are numerous deleterious physiologic changes which increase the risk of incurring heat illnesses when more than 2 gms of supplementary sodium chloride is ingested per day in hot environments. Use of supplementary sodium chloride must be based upon the medical history and current physical status of each individual.

(d) Water intake requirements are a function of work performed, the level of heat stress and the amount of salt consumed. Figure 3-5 shows the relationship of liters of water intake required as a function of heat stress, physical work and a "normal diet" sodium chloride intake of 15.0 gms per day. Figure 3-6 shows the same relationships but for 25.5 gms of sodium chloride per day with the Long Range Patrol Food Packet (FSN 8970-926-9222). In both Figures, no supplementary salt (salt packets) have been taken into account. The water requirements in both Figures need to be increased by 1 liter per day for every 6 gms of sodium chloride (e.g., 2 liters per day for 3 salt packets (12 gms of NaCl) per day in field rations).

(3) ***Special Programs.*** A program of special training schedules for obese personnel and other groups suspected of heat susceptibility will reduce systemic heat injuries. Training supervisory and administrative personnel should be taught to recognize the signs and symptoms of excessive heat strain and impending heat stroke and heat exhaustion in these men.

(4) ***Clothing.*** Clothing should be worn loosely at the neck, and at the cuffs of sleeves, and at the bottom of trousers to facilitate convective cooling. Some synthetic clothing materials interfere with evaporative cooling, although they may subjectively feel cooler. Poplin or other high natural fiber content clothes have good "wicking" characteristics and are superior materials for evaporative cooling. Navy dungarees are made from a mixed fabric, 35% cotton and 65% synthetic fiber, which does not seriously interfere with evaporative cooling. Physiological heat transfer comparisons have been made between Navy 100 percent cotton fire retardant coveralls (e.g., those used outside of engineering spaces) and mixed synthetic (5% Kevlar and 95% Nomex, known as "Aramid" and MIL-C–87093) fire retardant coveralls (e.g., engineering coveralls); no objective differences were found although personnel thought the mixed synthetic fiber coveralls were hotter. When the given mixed synthetic fiber coveralls were worn over underwear, like that with dungarees, there was no significant thermal difference between wearing the coveralls or dungarees. ***Physiological Heat Exposure Limit (PHEL) values do not need to be adjusted provided the coveralls are worn only over underwear.*** However, wearing either of the Navy coveralls over dungarees and underwear results in imposing a major heat load upon the body due to added insulation and weight; obviously

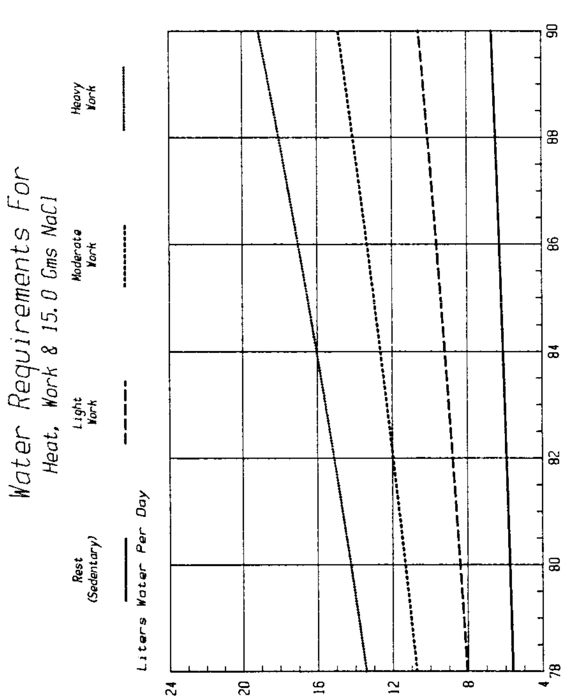


Figure 3-5.

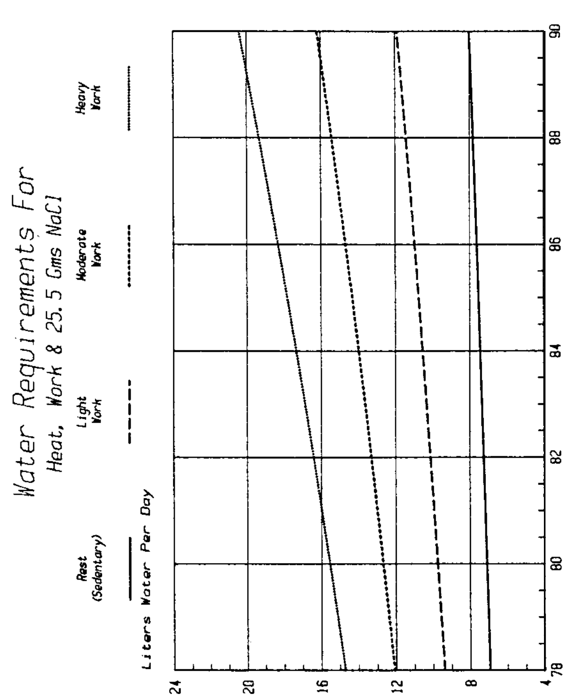


Figure 3-6.

this is a serious problem in the case of personnel being protected in damage control situations, but one must consider the added protection from fires. ***It is strongly recommended that coveralls not be worn over dungarees during damage or casualty control drills in hot and/or unventilated spaces, as this may readily induce heat exhaustion and heat stroke.*** Starch must not be utilized where evaporative cooling from clothing is a major factor. Outdoors, helmet liners or headgear of similar design provide more cooling and protection of the head than caps.

(5) ***Field Training Exercises.*** Training exercises requiring sustained or severe physical effort, and those conducted in the prone position should be scheduled, when possible, in early morning or at night. Outdoor classes should be conducted in the shade with adequate exposure to cooling wind. Even when training exercises are performed in early morning or at night, high metabolic heat production by those performing physical activity can induce heat exhaustion or heat stroke. One must, therefore, continue to be aware of all factors that may precipitate systemic heat injuries.

(6) ***Excessive Heat Stress.*** When environmental heat stress exceeds levels specified in Section IV, heat illness can be prevented by curtailing or suspending non-essential physical training and undue heat stress exposure. Obviously, operational mission requirements, excluding training programs, may preclude application of pertinent heat stress guides; in such cases the Medical Department must be forewarned in order to adequately prepare facilities and staff for the anticipated increased number of heat illnesses. Mental and physical dysfunction under thermal stress may be expected to amplify the frequency of accidental injury.

(7) ***Other Medical Measures.*** Other medical measures which will minimize the incidence of heat illnesses should be considered. Adequate recovery from acute or cumulative fatigue (at least 6 hours of uninterrupted sleep per 24 hours in a comfortable thermal environment), optimal physical fitness for the work to be done, absence of intercurrent illnesses, absence of febrile reactions (e. g., elevated body temperature due to immunizations), and absence of or minimal susceptibility to heat illnesses will aid in increased productivity of workers and help safe-guard their well being. Use of Navy educational films is strongly recommended (See Article 3-9(9) below).

(9) ***Educational Films.*** Navy educational films are available relative to the effects of heat stress, physical work, water requirements, sodium chloride intake and predisposing factors relative to heat disorders. The "all hands" film, "Heat Stress Monster" (35025-DN), is an animated film portrayal of multiple aspects of heat stress both ashore and afloat. On the other hand, "If You Can't Stand The Heat . . ." (35026-DN) is a counterpart film for supervisory level personnel afloat. Many of the informational aspects of this Chapter are presented in these films. Also see Article 3-2(2)(h) regarding the Navy educational film on "Care and Use of the Heat Stress Meter".

3-10. Effects of Cold

(1) The adverse effects of low environmental temperatures on the human body may be localized or generalized, or a combination of both. They may occur at temperatures above or below freezing and under wet or dry conditions. The pathophysiologic features of cold injury are dependent on the environmental temperature, exposure time and individual susceptibility or resistance. One form of adverse cold response has already been discussed under "cold shock" in Section 11, Article 3-6(4).

(2) ***General Physiologic Effects of Acute Cold Exposure.*** The physiologic response to total body cooling is manifested by the conservation of thermal energy and an increase in heat production. With prolonged or severe exposure, the defense mechanisms fail, heat loss exceeds heat production, and the body temperature falls. During the initial response to cold exposure, stimulation of the sympathetic nervous system causes a reflex superficial vasoconstriction with shunting of blood to the internal organs. This is accompanied by reflex shivering which increases muscular activity, heat production and oxygen consumption. Constriction of cutaneous capillary beds is manifested by pallor, mottling or cyanosis of the skin; in hypersensitive individuals histamine release may cause urticaria. In responding to stress the body secretes epinephrine which accelerates the cardiac rate, increases blood pressure and mobilizes liver glycogen stores. Blood coagulability is increased and pooling of water in the extravascular spaces (skin, muscle, subcutaneous tissues) results in hemoconcentration. Sudden exposure to extreme cold causes reflex muscle spasm and respiratory arrest. More gradual cooling eventually causes unconsciousness (88-89 F rectal) and is accompanied by slowing of respiration and heart rate, and falling of the blood pressure. Although some individuals have survived rectal temperatures as low as 72 F, ventricular arrhythmias (fibrillation) and cardiac arrest may be expected when rectal temperature falls below 80 F. In persons exposed to rain, snow, wind and cold, the onset of hypothermia may be insidious. The first warning may come with violent shivering, marked fatigue, stubbornest and hallucinations as the body temperature drops below 91-95 F. Unconsciousness and cardiorespiratory arrest may rapidly follow unless resuscitative efforts are begun immediately.

(3) ***Chronic Effects of Cold Exposure.*** It has been suggested that recurrent exposure to cold and to changes in environmental temperature may lower individual resistance to infectious disease. Research in this area is incomplete; therefore, definitive conclusions cannot be stated.

(4) ***Characteristics of Localized Cold Injury:***

(a) ***Nonfreezing Injury.*** Non-freezing injuries occur at ambient temperatures above 32 F, but below 50 F, and are most frequently manifested as chilblain (pernio) and cold water immersion foot (trench foot). Exposure time is variable but is usually measured in hours. A high environmental moisture favors non-freezing injuries by accelerating heat loss. Peripheral vasoconstriction, venostasis and increased blood viscosity impair normal tissue oxygenation and the removal of cellular metabolites. This may be accompanied by increased capillary permeability and intravascular agglutination or sludging of red blood cells. ***Chilblain is*** characterized by initial blanching and pallor—followed on rewarming by flushing, itching and edema. Blistering may be present and continued cold exposure may lead to hemorrhagic or ulcerative lesions. ***Cold water immersion foot*** may initially be no more troublesome than chilblain; however, prolonged exposure leads to more severe anoxic impairment. During the hyperemic phase the pain is usually severe, tissue destruction is more pronounced and gangrene may supervene with the resultant loss of the limb. Late complications of cold water immersion foot include dyshidrosis, Raynaud's phenomenon and causalgia. Secondary complications, including infection and thrombophlebitis, are not uncommon.

(b) ***Freezing Injury (Frostbite).*** The pathophysiology of frostbite is presently uncertain. It occurs only at environmental temperatures below freezing and the extent of tissue destruction depends primarily on the temperature and length of exposure. The freezing of intracellular and extracellular fluid results in the formation of ice crystals which mechanically disrupt cell membranes. There is a lack of agreement as to whether the injury is due to cellular injury and changes in vascular permeability or to the vascular stasis and tissue hypoxia. ***First degree frostbite*** is similar to mild chilblain with hyperemia, mild itching and edema; no blistering or peeling of the skin occurs. ***Second degree frostbite is*** characterized by blistering and desquamation. In ***third degree frostbite*** there is necrosis of the skin and subcutaneous tissues with ulceration. The most severe tissue damage is seen in ***fourth degree frostbite*** with destruction of connective tissues and bone accompanied by gangrene. Secondary infections and the sequelae noted for non-freezing injuries are not infrequent.

(5) ***Factors Influencing Cold Injury***

(a) ***Weather*** The prevention of cold injury is facilitated by the availability of accurate meteorological information, including air temperature, humidity and wind velocity. For practical purposes, the cooling effect of air temperature and wind velocity have been combined in the ***Equivalent Temperature*** standard (Wind ***Chill Index Chart)*** which is presented in Section IV.

(b) ***Physical Work.*** Heavy physical activity may accentuate heat loss by perspiration; in addition, the moisture becomes trapped in-excess clothing and reduces its insulating capacity. Prolonged excessive activity leads to mental and physical fatigue which may lead to fatal hypothermia in a cold environment. Total immobility, on the other hand, decreases the production of body heat with cooling of the extremities and circulatory impairment in dependent parts. It is advisable, therefore, to tread the middle ground and recommend moderate activity with adequate rest. Increased exercise of the extremities should be encouraged when personnel are in confined positions in cold climates.

(c) ***Physical Well-Being and General Health.*** Persons with previous cold injury, especially that of recent origin, heavy smokers and those taking medications which affect the vasomotor tone are at special risk in cold environments. Seriously wounded individuals with significant blood loss and decreased activity are predisposed to cold injury as are those on starvation or near-starvation diets. Consumption of alcoholic beverages causes vasodilation and accelerates heat loss, thus favoring the development of frostbite and hypothermia.

(d) ***Personal Characteristics.*** Although the epidemiologic reasons are unclear, younger lower ranking personnel, Caucasians from United States climates with minimum January temperatures above 20 F, and American Blacks appear to share an increased hazard of developing cold injury. Persons with negativistic behavior patterns are also at risk. Therefore, line commanders and Medical Department personnel may find it particularly valuable to concentrate preventive education among these individuals.

(e) ***Clothing.*** Protective clothing, available when needed and properly worn, is essential to conservation of body heat. Garments should be clean, dry and allow for adequate air circulation between and through layers. Apparel should be fitted so as to avoid peripheral limb constriction with attending circulatory impairment. The feet and hands require special care in order to avoid maceration of the skin and secondary infection. This is best accomplished by adequate changes of socks and gloves and liberal use of soap and water cleansing. When possible, footgear should be dried between periods of use.

(f) ***Preventive Education.*** All personnel should be oriented to their individual responsibility in the prevention of cold injuries. Predisposing and preventive factors should be widely promulgated, and negative attitudes discouraged.

(6) ***Treatment of Local Cold Injuries***

(a) ***First Aid.*** Frozen body parts should be rewarmed until thawed. This can be accomplished by immersion in a water bath of 104-106 F; temperatures above this level should be strictly avoided. In the field where water is not available, the part may be-warmed in the axilla of a normothermic companion. In most cases the frozen body part has already thawed by the time the victim comes for initial treatment and further active warming measures are not required. Wet clothing should be removed and body parts dried and protected from trauma. Blisters should be left intact and sterile fluff dressings applied. Deep body temperature should be maintained with blankets and warm liquids. All individuals with cold injury of the extremities should be managed as litter patients with the limb slightly elevated. All cold injury victims should be evaluated by qualified Medical Department personnel as soon as possible.

(b) AVOID: COLD-INJURED PARTS SHOULD NOT BE RUBBED WITH SNOW OR ICE WATER OR OTHERWISE TRAUMATIZED. BECAUSE OF THEIR EFFECTS ON CAPILLARY CIRCULATION, THE USE OF ALCOHOLIC BEVERAGES AND TOBACCO IS STRICTLY CONTRAINDICATED.

OINTMENTS AND CREAMS SHOULD NOT BE APPLIED.

(c) ***Symptomatic Care.*** Pain is sometimes severe in rewarmed limbs and may require administration of narcotics for relief. Itching and urtication may be relieved by antihistaminics and milder analgesics.

(d) ***Definitive Therapy:***

(1) Affected parts should be kept clean and either treated "closed" with sterile dressings or "open" with sterile sheets and proper nursing precautions.

(2) Tetanus boosters should be given where indicated.

(3) Since frostbite victims are frequently dehydrated, they may benefit from the administration of Lactated Ringer's Solution. Low-molecular-weight dextran or Heparin may be indicated if vascular "sludging" or thrombophlebitis are suspected.

(4) In frostbite devitalized and gangrenous tissues may separate spontaneously after 60-90 days. Sympathectomy may be indicated in severe cases of frostbite and immersion foot to relieve causalgic pain. Surgical debridement may become necessary as well as skin grafting. Amputation should be conservative.

(5) Physical therapy includes early active and passive movement of affected parts and later rehabilitation of compromised function.

(6) Antibiotic therapy may be necessary if secondary infection becomes a problem, and should ideally be guided by bacterial culture and sensitivity testing evidence.

(e) ***Disposition.*** All episodes of cold injury should be documented in the patient's medical records. Recurrent episodes may be cause for reassignment or medical board.

(7) ***Clinical Manifestations and Treatment of Generalized Hypothermia:***

(a) Generalized hypothermia may be classified as ***induced*** or ***accidental. Induced hypothermia is*** a valued adjunct to general anesthesia for select surgical procedures. It is implemented under controlled conditions by qualified personnel. Vital functions (circulatory, respiratory, cardiovascular) are carefully monitored as the body temperature is lowered and maintained for the duration of the surgery. Temperatures are generally maintained above 82 F. ***Accidental hypothermia*** may be observed in newborns, in the elderly and in association with certain lesions of the endocrine and central nervous systems. In the military, it is most frequently seen in individuals who have been exposed to cold for prolonged periods of time. Fatigue, severe wounds, cold water immersion (aircraft, ship and submarine accidents), and inadequate cold weather gear contribute to the evolution of accidental hypothermia. Case reports suggest that tolerance to deep hypothermia (77 F) may occasionally be enchanced by the depressant effect of alcoholic intoxication and excessive doses of sedative drugs. This phenomenon, however, is unpredictable and should never be considered in the context of therapy. Individual cold tolerance and the unreliability of the clinical signs of "death" during severe hypothermic episodes make it imperative that resuscitative measures be instituted immediately in all cases of accidental hypothermia. Cardiovascular and respiratory support should ideally be continued until it can be confirmed by more sophisticated means that all signs of life are absent.

(b) ***Clinical Manifestation of Hypothermia.*** The patient is pale, comatose, and may appear dead. Respirations are slow and shallow and may be difficult to detect. The pulse is faint or absent, the precordial impulse may be inapparent and the blood pressure is frequently unobtainable. The victim is hyporeflexic and unresponsive to painful stimuli. Pupils are unreactive to light, but are usually not dilated. The body tissues are semirigid and resist passive movement. Body temperatures are frequently below 82 F (rectally), and cannot be measured with the usual clinical thermometers (See below for Subnormal Clinical Thermometer). Urine output is negligible. Death may occur in spite of apparently successful resuscitative measures.

For clinical monitoring of hypothermic patients, there is a special thermometer available. The following information is provided:

> Thermometer, Clinical Human, Oral/Rectal, Subnormal(Range 70-100 F) Stock number 9L-6515-00-139-4593

(c) ***Therapy of Accidental Hypothermia:***

(1) ***Genera{ Measures.*** Initial resuscitative measures should concentrate on the restoration of vital functions. If respirations are present and ventilation is adequate, the therapists attention may be diverted to other resuscitative measures. Otherwise mouth-to-mouth resuscitation and external cardiac massage (if indicated) should be initiated in the field. The patient should be kept warm during transportation to a medical facility and examined for concurrent injury and drug or ethanol intoxication. Supplemental oxygen will usually be indicated. An oral airway should be inserted. Upon arrival at a medical facility, the apneic patient should have an endotracheal airway inserted to aid mechanical ventilation and suction. Intravenous lines should be established for the administration of resuscitative fluids and the measurement of central venous or pulmonary wedge pressures. A nasogastric tube will allow evacuation of stomach contents and prevent aspiration, and an indwelling urinary catheter will serve to monitor urine output. Blood gas, pH, and electrolyte determinations will aid in effective management. Body temperature is best monitored by rectal thermistor probe, otherwise use the subnormal clinical thermometer noted above.

(2) ***Rewarming.*** Rewarming must be approached with caution in order to avoid serious consequences. Controversy still exists as to the most effective and safest means by which to restore normal body temperature. ***Rapid rewarming*** appears to be the most effective in cases where cold exposure (most frequently cold water immersion) has been brief. It is accomplished by total body immersion in warm water (about 104 F). Hypothermic patients, however, may be inadvertently burned by this approach and are subject to the poorly understood phenomenon of "rewarming shock". Slow ***re-***

warming may be accomplished by the use of blankets, hot water bottles, etc.; however, care should again be taken that the differential temperature between the patient and the rewarming medium is not too great. ***The age old method of vigorously massaging the patient is dangerous and is contraindicated.***

(3) Cardiopulmonary Care. Vital signs should be closely monitored under intensive care nursing procedures. After restoration of respirations assisted ventilation and oxygen may be continued. Electrocardiographic monitoring is indicated. Ventricular arrhythmias (ventricular premature beats, tachycardia, and fibrillation) are not infrequent in severe hypothermia; intraventricular conduction delays are common and a "J-point" may be seen at the very end of each QRS complex. Digitalis may be indicated for rapid atrial fibrillation associated with a rapid ventricular response. Ventricular arrhythmias may be treated with lidocaine or procainamide; however, recent evidence suggests that quinidine and beta-adrenergic blocking agents (propranalol) may have a more predictable pharmacologic effect.

(4) ***Metabolic and Fluid Balance.*** Restoration of circulating fluid volume should be monitored by central venous or pulmonary wedge pressures. Blood gas and pH determinations are useful in following repair of the severe metabolic acidosis which accompany profound hypothermia. Ringer's lactate is the restorative fluid of choice, and may be supplemented with sodium bicarbonate solution as indicated. Overzealous measures can lead to serious fluid overloading of the cardiopulmonary circulation. Marked hypoglycemia is best managed by the administration of glucose. Physical exhaustion and prolonged stress can lead to adrenal insufficiency; therefore, the administration of 200 mg of hydrocortisone intravenously may be indicated in some cases. Hypokalemia is common, but is probably due to intravascular electrolyte shifts and does not usually require vigorous replacement.

(5) ***Lute Measures and Complications.*** Associated injuries can be dealt with when rewarming is completed. Intensive care measures are needed only until the cardiopulmonary, metabolic, and thermoregulatory functions have stabilized. Patients must be watched for acute renal failure and pulmonary infection.

(8) ***Sensitivity to Cold.*** Sensitization to further cold exposure frequently follows all forms of cold injury. The sensitivity may be brief with milder injuries or last for years after severe episodes. Hypersensitivity to cold (cold allergy) may be observed as a familial trait or a sequela of cold injury. It is manifested by the appearance of generalized urticaria following cold exposure and may occasionally be complicated by bronchospasm (asthma) and shock.

warming may be accomplished by the use of blankets, hot water bottles, etc.; however, care should again be taken that the differential temperature between the patient and the rewarming medium is not too great. ***The age old method of vigorously massaging the patient is dangerous and is contraindicated.***

(3) Cardiopulmonary Care. Vital signs should be closely monitored under intensive care nursing procedures. After restoration of respirations assisted ventilation and oxygen may be continued. Electrocardiographic monitoring is indicated. Ventricular arrhythmias (ventricular premature beats, tachycardia, and fibrillation) are not infrequent in severe hypothermia; intraventricular conduction delays are common and a "J-point" may be seen at the very end of each QRS complex. Digitalis may be indicated for rapid atrial fibrillation associated with a rapid ventricular response. Ventricular arrhythmias may be treated with lidocaine or procainamide; however, recent evidence suggests that quinidine and beta-adrenergic blocking agents (propranalol) may have a more predictable pharmacologic effect.

(4) ***Metabolic and Fluid Balance.*** Restoration of circulating fluid volume should be monitored by central venous or pulmonary wedge pressures. Blood gas and pH determinations are useful in following repair of the severe metabolic acidosis which accompany profound hypothermia. Ringer's lactate is the restorative fluid of choice, and may be supplemented with sodium bicarbonate solution as indicated. Overzealous measures can lead to serious fluid overloading of the cardiopulmonary circulation. Marked hypoglycemia is best managed by the administration of glucose. Physical exhaustion and prolonged stress can lead to adrenal insufficiency; therefore, the administration of 200 mg of hydrocortisone intravenously may be indicated in some cases. Hypokalemia is common, but is probably due to intravascular electrolyte shifts and does not usually require vigorous replacement.

(5) ***Lute Measures and Complications.*** Associated injuries can be dealt with when rewarming is completed. Intensive care measures are needed only until the cardiopulmonary, metabolic, and thermoregulatory functions have stabilized. Patients must be watched for acute renal failure and pulmonary infection.

(8) ***Sensitivity to Cold.*** Sensitization to further cold exposure frequently follows all forms of cold injury. The sensitivity may be brief with milder injuries or last for years after severe episodes. Hypersensitivity to cold (cold allergy) may be observed as a familial trait or a sequela of cold injury. It is manifested by the appearance of generalized urticaria following cold exposure and may occasionally be complicated by bronchospasm (asthma) and shock.

Section IV. THERMAL STANDARDS

3-11. General Requirements

(1) The major objectives of the thermal standards are to facilitate mission accomplishment by maximizing productivity and maintaining the well-being of personnel.

(2) ***Elimination of Smoke and Noxious Odors.*** Smoke and noxious odors are readily detectable in closed spaces. Ventilation rates to eliminate odors from berthing areas and living quarters are considerably in excess of those required to supply oxygen and remove carbon dioxide. Attempts to filter or mask unpleasant odors have not met with significant success. Tobacco smoke is likewise difficult to remove from confined spaces aboard ship, particularly in submarines where air is recirculated. Noxious odors are not physically harmful, but tend to exert an unfavorable effect on appetite and morale. Tobacco smoke, on the other hand, may have varied harmful effects on smokers as well as non-smokers. Personnel exhibit a variable tolerance for tobacco smoke with some individuals developing symptoms of hypersensitivity (allergy). Smoke acts as an irritant to the eyes and respiratory membranes. Smoking should be prohibited in spaces where the carbon monoxide content of the air exceeds the following limits:

(a) 25 parts per million and continuous exposure for 90 days.

(b) 50 parts per million and exposure for 8 hours daily.

(Other standards exist depending on the length of exposure, physical activity performed and requirements for mental acuity.)

(3) ***Elimination of Fuel Combustion Gases and/or Fuel Vapors.*** Fuel combustion gases and fuel vapors have toxic effects upon personnel. In the area of thermal physiology, these gases and vapors cause vasodilation of the peripheral blood vessels at times when cardiovascular stability has already been compromised. Since humans cannot increase their existing circulating blood volume to compensate for the marked increase of their cardiovascular system capacity, the resultant effect is to incur further impairment of the cardiovascular system to meet the physiologic demands of the work and environment. This produces a critical impact when the added

load of heat stress is present. The ambient concentrations of aromatic hydrocarbons, using hexane as the reference gas for quantitative analysis, which produce such responses in humans is between 10-14 mg/m^3 of air. Higher concentrations of aromatic hydrocarbons have relatively little further effect on human short-term exposure; concentrations as high as 690 mg/m^3 have not resulted in significant changes from that measured at the lower concentrations. One must be aware that the threshold concentrations for aromatic hydrocarbons and oxides of nitrogen and sulfur, in combined environmental stress situations, appear to be quite low. Cardiovascular "shock" occurs without significant hyperthermic responses. Table 3-4 generalizes some of the physiologic impact of fuel combustion gases and fuel vapors where 135 personnel exhibited and sensed body changes due to the presence of these gases and vapors aboard Navy ships in mild heat stress situations. In all cases, the Physiological Heat Exposure Limits (PHEL) times alone were 4–6 hours, but the personnel exposures had to be terminated quite prematurely when the overall effects justified removal for physiological safety purposes.

Since the physiologic thresholds of the gases and vapors are low, the results from calorimetric detector tubes used aboard ships should be considered unreliable. Research has shown that ambient water vapor results in false low values from a variety of calorimetric detector tubes, water molecules occupy sites in the chemical beds and thereby reduce the number of available sites for

Table 3-4. General Physiologic Impact of Fuel Combustion Gases and Fuel Vapors

Parameters	Change
Cardiovascular:	
Heart Rate	Slight increase
Systolic Blood Pressure	Marked reduction
Diastolic Blood Pressure	Marked reduction
Mean Arterial Blood Pressure	Very marked reduction
Estimated Cardiac Output	Marked increase
Total Vascular Resistance	Very marked reduction
Overall Cardiovascular Reserve	Very marked reduction
Sensory:	
Tip of Tongue	Tingling/numbness
Nose	Tingling/numbness
Finger Tips	Tingling/numbness
Toes	Tingling/numbness
Eyes	Lacrimation
Respiratory	Distress
Body Temperatures	No apparent change at time of exiting environment

reactions to occur in the detector tubes. Gas free engineering methods, generally available aboard ships, cannot reliably measure these low levels of likely toxic components in fuel combustion gases and fuel vapors that are pertinent to this subject. Portable, direct reading instrumentation which is durable, accurate at low concentrations, has specificity for a variety of atmospheric components, has a high degree of reproducibility, maintains calibration and has an adequate response time is extremely expensive. We are left with the difficulty of estimating the presence of physiologically significant levels of atmospheric contaminants and what to do to minimize the impact upon personnel, especially if the contaminants are permitted to remain in work spaces.

Fortunately, the Physiological Heat Exposure Limits (PHEL) Chart and information available regarding the sensory, eyes and respiratory responses of shipboard personnel in such environments exists. During what would normally be 4-6 hour heat stress exposure limits, it was repeatedly found that the physiologically safe exposure times could be determined by use of the PHEL Chart. Using the methods described in this Chapter and the OPNAVINST 5100.20 series for determining the WBGT Index and PHEL times, ***reduction of the determined PHEL exposure times by 66% would minimize the reduced physiologic performance of personnel.*** For example, a PHEL stay time of 4 hours becomes 1.4 hours (1 hr 24 reins) and 6 hours becomes 2.1 hours (2 hrs 6 reins). Therefore, adjustment of the PHEL values for heat stress exposures provides a simplified means of estimating physiological exposure times to fuel combustion gas and fuel vapor pressures, with and without the presence of limiting heat stress. Regardless, ***long-term, repetitive exposures to such atmospheric contaminants may have other far more serious consequences to the well-being of personnel.*** Obviously, the elimination of personnel exposures to fuel combustion gases and fuel vapors that adversely impact upon the health of personnel should be an engineering and operational goal. Personnel exposures to fuel combustion gases and fuel vapors must be prohibited on a routine basis, emergency exposure situations should be the only exception.

(4) ***Air Supply for Ventilation.*** One of the most important factors in the design of a ventilating system is the uniform distribution of air. Under favorable conditions the required air supply can be obtained by natural ventilation methods without creating objectionable drafts. The ***maximal*** air supply should be governed by thermal requirements for maintaining the desired working, living and messing space conditions indicated in Section II of this chapter. In cool or cold atmospheres, it is desirable to limit the velocity of air currents to within the threshold of perceptibility so far as to impart a sense of freshness without producing unpleasant drafts. The velocity at which room currents become noticeable varies with the dry- and wet-bulb temperatures, and ranges from a low of 10 fpm in cold environments to about 80 fpm or higher in warm environments. In order to avoid drafty conditions, air movement in cool atmospheres should be maintained at less than 50

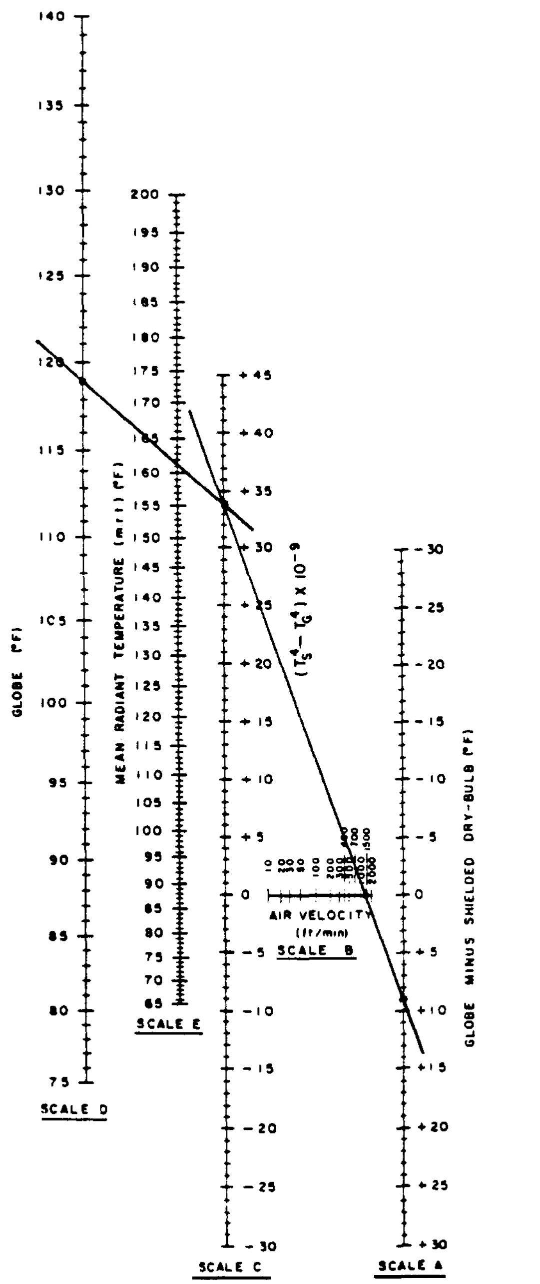
fpm; in warm conditions it should be kept between 100-200 fpm. Intermittent exposure to much higher velocities is indicated in the presence of radiant heat; however, reference should be made to the special considerations indicated in Section H, 3-7 (5) and (6). For natural ventilation it is good practice to select the point of air entry in order to control the volume and distribution. Selective entry of air through specific openings or by "infiltration" allows for thermal tempering before it reaches living or working spaces. When untempered air passes over personnel, it can result in chilling and complaints of drafts. Some individuals may then demand increased heating of a space to the dissatisfaction of other occupants. "Foot drafts" may be due to faulty ventilation or to variable vasomotor circulatory response in the extremities. It is best managed by selective use of suitable clothing. In firerooms and engine rooms the preferred minimal *effective air velocity* over personnel is 250 fpm. Air blowing between 250-1500 fpm on the head and shoulders will result in relatively little gains in effective cooling, beyond 1500 fpm there will be reduced effective cooling, while above 2080 fpm will result in heating of dry skin (See Figure 3-2).

(5) ***Air Supply Requirements for Respiration and Elimination of Smoke and Odors. Outside*** air supply to spaces where light work is performed should not be less than 425 liters (15 cubic feet) per minute per person; or 2 air changes per hour, whichever is greater. Where the work load is heavy, the outside air supply should be increased to 566 liters (20 cubic feet) per minute per man, or 3 air changes per hour. In spaces where smoking is permitted, 850 liters (30 cubic feet) of air should be provided per minute for each smoker. In living spaces 850 liters (30 cubic feet) of air should be supplied per minute per designed occupancy; messing areas should be provided with 566 (20 cubic feet) per minute per person eating during maximum occupancy. These are *minimal* air quantities for the removal of noxious odors and smoke and are not intended as standards for the removal of potential industrial contaminants.

3-12. Assessment of Heat Stress

(1) The empirical heat balance equation presented in Section 111 summarizes the environmental and metabolic parameters which constitute an individual's thermal load in a given environment. Efforts to develop an all-encompassing heat stress index, that unconditionally describes all thermal variables in all situations, have met with varying degrees of both success and failure. The usefulness of a single thermometer in the measurement of heat stress conditions is extremely limited. Engineering surveys of *heat stress* require separate readings (dry-bulb, wet-bulb, globe, and surface temperatures plus air velocities) at the supply duct face (opening) and at the work location. Environmental physiology studies of *heat stress* require the foregoing measurements in addition to the assessment of human body temperatures and individual work loads. The evacuation of *heat strain* requires all of the above measurements as well as a worker's heart rates, blood pressures and pre- and post-exposure body weights.

(2) ***Mean Radiant Temperature (mrt).*** In calculating the radiant heat balance between man and his environment, one must first estimate the mean radiant temperature of the surroundings. This may be calculated in various ways using the *globe and dry-bulb temperatures,* and the *air velocity* data noted above. The simplest method is by use of the nomogram illustrated in Figure 3-7. The difference between the globe and dry-bulb



ESTIMATION OF MEAN RADIANT TEMPERATURE (m.r.t)(°F)

Figure 3-7.

temperatures is entered on *Scale A;* a line is then drawn from this point through the point representing the appropriate air velocity on *Scale B,* and continuing until it intercepts *Scale C,* lastly, a line is drawn from the point representing the globe temperature on *Scale D,* so that it meets the intercept point on *Scale C* the mean radiant temperature is read from the point at which the second line crosses *Scale E.* To illustrate, let us suppose that the globe temperature = 119 F, the dry-bulb temperature = 110 F, and the air velocity = 1500 fpm; the mean radiant temperature is read from Scale E as being equal to approximately 161.5 F.

The more precise means of obtaining mean radiant temperature is by use of the following fourth power equation:

$$(T_S + 460)^4 \times 10^{-9} = (T_G + 460)^4 \times 10^{-9} + 0.1028\ V^{0.5}(T_G - T_{DB})$$

where

T_S = temperature of the surrounding environment (°F)
T_G = globe temperature (°F)
T_{DB} = dry-bulb temperature (°F)
V = air velocity (fpm)

The calculated mean radiant temperature is within approximately 1 F of that obtained by the simplified method using the nomogram.

Frequently persons overlook the importance of mean radiant temperature on workers. Figure 3–8 illustrates the mean radiant temperatures where low, moderate, high and excessive body heat storage occurs. Therefore, in our example given above, *the mean radiant temperature of 161.5 F is within the range of excessive body heat storage. This* emphasizes the need for radiant heat control in workplaces.

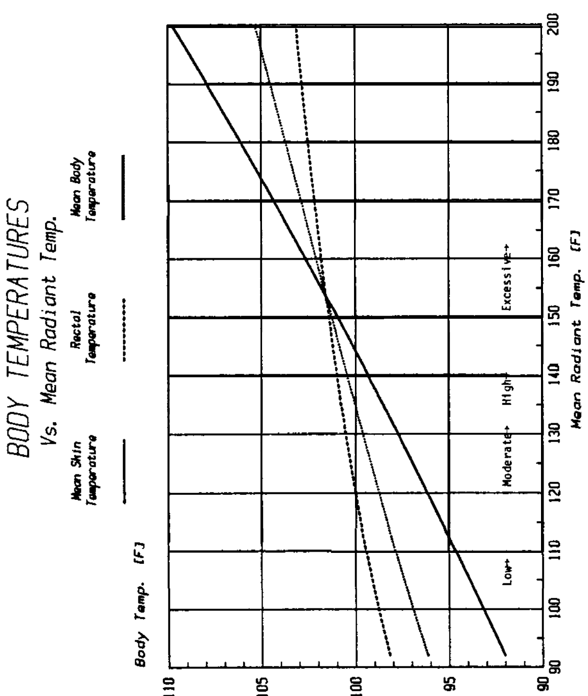


Figure 3–8.

(3) ***Radiation.*** The radiant heat transfer balance between a given subject and the environment may now be calculated using the following formula:

$$R = 6.27\ (\text{m.r.t.} - T_{sk}) \text{ assuming no clothing on the subject}$$

where

R = radiation (Kilocalories per hour)
m.r.t. = mean radiant temperature (°F)
T_{sk} = mean skin temperature (°F)

The value for R should be reduced by 30-40% for individuals insulated by clothing (the use of blue denim dungarees requires a 30% reduction factor).

(4) ***Convection.*** Heat exchange by convection is calculated by using the following formula:

$$C = 0.27\ V^{0.6}(T_{DB} - T_{sk}) \text{ assuming an unclothed subject}$$

where

C = convection (Kcal/hour)
T_{DB} = dry-bulb temperature (°F)
T_{sk} = mean skin temperature (°F)

The value for C should be reduced by 30-40% to account for the insulative effects of clothing (again 30% reduction for blue denim dungarees).

(5) ***Evaporation Estimates***

(a) ***Evaporation Required (Ereq):*** Evaporation required to maintain a normal heat balance within the human subject is calculated using the following equation:

$$E_{req} = M \pm R \pm C$$

where

E_{req} = evaporation required to maintain heat balance (Kcal/hr) assuming no heat storage if heat loss by E_{req} can be accepted by the environment
M = metabolic heat production by the subject (Kcal/hr)
R = radiation (Kcal/hr)
C = convection (Kcal/hr)

The equation assumes that conduction will be minimal if the subject is not in contact with a surface hotter or colder than his surface temperature and if heat transfer through the shoes is negligible.

(b) ***Maximum Evaporative Capacity (Emax):*** The maximum amount of heat, lost by evaporation, which can be accepted by the environment (maximum evaporative capacity of the environment) is calculated from the following equation:

$$E_{max} = 1.01 \; V^{0.6} (42 - VP_a)$$

where

E_{max} maximum evaporative capacity (Kcal/hr)
v = air velocity (fpm)
VP_a = Partial vapor pressure of the environment (mm Hg.) at the combined dry-bulb and wet-bulb temperatures.
42 = vapor pressure at the skin of the subject assuming a mean skin temperature of 95° F; this figure will differ by approximately 1.3 mm Hg for each 1°F change in the mean skin temperature from 95ºF.

The value for Emax should be reduced by 30-40% to account for the insulative effect of clothing (blue denim dungarees require a 30% reduction factor).

(6) ***Heat Stress Index (Belding-Hatch):*** The Heat Stress Index (HSI) is calculated as the ratio of the Evaporation Required (Ereq) to the Maximum Evaporative Capacity (Emax):

$$HSI = \frac{E_{req}}{E_{max}} \; X \; 100$$

The HSI is an expression of heat load in terms of the amount of sweat which needs to be evaporated in order to maintain heat balance. The index compares the amount of heat lost by evaporative cooling from completely wetted skin to the maximum evaporative capacity of the environment. The HSI was considered useful in subjectively estimating metabolic heat production during different categories of physical activity. Estimates of various types of metabolic rates during different physical activities are given in Table 3-5.

The Heat Stress Index was originally intended for application among men working 8-hour shifts in civilian industry. Investigation, however, has shown that a negative (–) index occurs when the vapor pressure of the skin is lower than the partial vapor pressure of the environment; this can happen even when the mean skin temperature is in the range of 101-110 F. Thus, *although a negative HSI theoretically indicates cold strain (See* Table 3-6) *it can,* in fact, *occur in the presence of severe heat strain.* The limitations of the HSI required development of a more reliable means of assessing *maximum safe exposure time* in the presence of heat stress. A more reliable exposure limit index has been developed and is discussed later in this section under the heading of *Physiological Heat Exposure Limits* (PHEL). Notwithstanding the contradictory nature of the HSI, the equations given in the preceding text are of use in partitioning the avenues of heat loss and gain between the subject and the environment.

(7) ***Wet-Bulb Globe Temperature Index (WBGT).*** As derived, the WBGT Index was unique in that it took into account the four physical variables of the thermal environment (air temperature, humidity, radiant heat and air movement). The simplicity of the approach was that one need not perform direct measurement of air velocity and that the globe thermometer integrates radiant heat and convective heating or cooling into one value. [Note: *The globe temperature is neither radiant heat by itself nor what is known as the mean radiant*

Table 3-5. Identification Of Approximate Metabolic Rates

Physical Activity	Average Metabolic Rate $KCal*m^{-2}*hr^{-1}$
a) ***Sitting***	
Moderate arm & trunk movement (e.g., typing, drafting, driving a car in light traffic)	68
Moderate arm & leg movement (e.g., general laboratory work, slow movement about an office)	82
Heavy arm & leg movement (e.g., driving a car in moderate traffic)	99
b) ***Standing***	
Light work at machine or bench, mostly arms	82
Light work at machine or bench, some moving about (e.g., using a table saw, driving a truck in light traffic)	99
Moderate work at machine or bench, some walking about (e.g., replacing tires, driving a car in heavy traffic)	119
c) ***Walking About, with Moderate Lifting or Pushing*** *(e.g.,* driving a truck in moderate traffic, scrubbing in a standing position)	**164**
d) ***Intermittent Heavy Lifting, Pushing or Pulling*** *(e.g.,* sawing wood by hand, calisthenic exercise, pick and shovel work)	238
e) ***Hardest Sustained Work***	300

temperature; the globe temperature value is a composite of radiant and convective heat transfers.]

Initial practical applications of the WBGT Index equations were to estimate ranges of heat stress that warranted decreasing physical activity in order to minimize incidence of heat injuries outdoors. It has been assumed by many persons over at least the last 20 years that the two-variable combination of wet and dry bulb temperatures applies *indoors,* while the three-variable equation applies only *outdoors.* In reality, *there are no less than eight equations for obtaining the WBGT Index;* therefore, *selection of the most appropriate WBGT Index equation became a serious matter in terms of the limitations of some of the equations.*

Table 3-6. Physiological Implications Of The HSI (Belding-Hatch)

HSI	Physiologic and Behavioral Implications
-20 to -10	Mild cold strain. (See implication of negative HSI above) This condition frequently exists in areas where men recover from exposure to heat.
0	No thermal strain.
+ 10 to +30	Mild to moderate heat strain. Where a job involve! higher intellectual function, dexterity, or alterness, subtle to substantial decrements in performance may be expected. In performance of heavy physics work, little decrement unless ability of individuals to perform such work under no thermal strain is marginal.
+40 to +60	Severe heat strain, involving a threat to health unless personnel are physically fit. Break-in period required for those not previously acclimatized. Some decrement in performance of physical work is to be expected. Medical selection of personnel desirable because these conditions are unsuitable for those with cardiovascular or respiratory impairment or with chronic dermatitis. These working conditions are also unsuitable for activities requiring sustained mental effort.
+70 to +90	Very severe heat strain. Only a small percentage of the population may be expected to qualify for this work. Personnel should be selected (a) by medical examination, and (b) by trial on the job (after acclimatization). Special measures are warranted to assure adequate water and salt intake (See Section III). Amelioration of working conditions by any feasible means is highly desirable, and may be expected to decrease the health hazard while increasing efficiency on the job. Slight "indisposition" which in most jobs would render workers unfit for this exposure.
+ 100	The maximum strain tolerated by fit, acclimatized young men for 8-hour exposures.
Above + 100	Overstrain, for 8-hour exposures. Tolerance of brief exposures will depend not on the amount by which the HSI exceeds + 100 but on the rate of heat accumulation by the body.

[Note: In steam, diesel and nuclear shipboard situations the level of heat stress frequently exceed physiological limits for at least 4-hour exposures. Therefore, one must consider a composite of heat stress and strain, behavioral, other physiological and time factors before application of the HSI to work situations less than the 8-hour design criteria.]

From 1963-1968, volumes of data were reviewed and compared with the Navy Bureau of Ship files. Literature searches and computer plotting of all available data indicated that maximum utility, for both engineering and environmental physiology purposes, would be obtained by use of the below WBGT equation. This was a major change from the comfort assessment concept of Effective Temperature and use of the WBGT Index.

WBGT = [(0.7 * Shielded Psychometric Wet Bulb)
+ (0.2 * Matte Black Globe Temp.)
+ (O. 1 * Shielded Dry Bulb Temp.)]

Extremely complex heat-work physiology experiments were conducted between 1968– 1975 in a large number of heat stress and work situations ashore and afloat. Seventeen physiological factors were employed, along with environmental variables and a wide range of work loads, to develop comprehensive physiological heat exposure limits criteria. Therefore, combining the given WBGT equation with the physiological responses led to development of the Physiological Heat Exposure Limits (PHEL). [Refer to: National Bureau of Standards, Special Pub. 491, pp 65-92, September 1977.]

Application of WBGT equations other than that given above for determining PHEL values is an extremely dangerous practice. There is too great a chance of being wrong in terms of physiologically safe but reversible limits of human heat stress exposures with other WBGT equations. Obviously one may find some theoretical situations where it makes no difference which equation is applied, however, for practical purposes, maximizing the utility of environmental data for many constructive and corrective engineering and environmental physiologic purposes, minimizing the risks to humans yet obtaining the longest safe stay times, there must be consistency in applying the above WBGT equation. The Navy heat stress meter is designed to be consistent with use of the given WBGT equation.

Only by use of above given WBGT equation, providing the raw data used for the calculations, including the air velocity over man, indicating what clothing is worn and providing sufficient information whereby human metabolic rates can be predicted will permit maximum analyses of the environmental physiologic situation. Whenever possible all available information should be provided ! Furthermore, extreme care should be taken to specify the presence or absence of air contaminants that may combine to have either a positive or negative impact upon humans at even low levels of heat stress. One must be continually aware of the fact that it is impossible for humans to be exposed to only one variable simultaneously in a non-laboratory environment. *It is essential to think in terms of dynamic situations where multiple environmental stresses result in various physiologic changes that occur in compensable or intolerable situations.* One must know as many possible individual variables to constructively analyze the work situation in terms of the physiological well-being of workers.

(8) ***Physiological Heat Exposure Limits (PHEL).*** U.S. Navy Physiologic Exposure Limits (PEL) were first established in 1971, however, in 1973 the Environmental Protection Agency circulated a series of Public Exposure Limits (PEL) covering a broad range of exposure limits which did not include heat stress. Furthermore, aware of the Navy's PEL for heat stress, the National Institute of Occupational Safety and Health (NIOSH) published their Permissible Exposure Limits (PEL) for heat stress in September 1973. In order to avoid confusion regarding the acronyms PEL the Navy, in December 1973, adopted the more descriptive title *"Physiological Heat Exposure Limits"* (PHEL). These criteria consisted of the previously published *Physiological Exposure Limits* of 1971 with an additional curve for heavy work as in casualty control. The Navy limits recognize that under conditions of maximum work and heat stress the heat strain will be readily apparent, but that it will be reversible; NIOSH Permissible Exposure Limits, on the other hand, were designed to restrict deep body temperature rises to a maximum of 100.4 F. In numerous work situations it is unrealistic to limit work at a rectal temperature of 100.4 F.

Compliance with the Navy's PHEL takes into account the multiple physiological factors relative to the welI-being of personnel. The PHEL applies to greater than 95070 of the population, as there will always be someone who may occasionally exceed the limits before incurring heat exhaustion or heat stroke. For the purpose of comparison, exceeding the PHEL is the same as stretching a rubber band close to its break point; sooner or later the rubber band is going to break. Serious personnel heat injuries can be expected whenever the PHEL are exceeded, therefore, stretching the rubber band close to its limits too many times is courting disaster.

(a) ***Criteria for PHEL Chart Development.*** The development of the PHEL curves entailed considerable heat stress research among personnel whose ages ranged from 18-40 years. Physiologic measurements included nine cardiovascular and four respiratory functions and related them to the total cardiovascular reserves. Three internal body temperatures and 10 skin temperatures were serially recorded. The criteria for determining maximum safe physiological exposures was based upon a composite of the above parameters (Refer to National Bureau of Standards, Special Publication 491, pp 65-92, September 1977). The absence of muscle damage under variable conditions of heat stress was verified by enzyme assay. In addition, subjects were monitored for the occurrence of hyperventilation and changes in mental status, particularly for euphoria. The measurements were made before, during and following sustained physical work in controlled heat stress conditions. These findings were compared with a wide range of environmental conditions aboard ships from 197 1-1976; the field data, using over 200 healthy Navy personnel, compared equally with the involved laboratory studies.

Time-weighted-means were calculated for both metabolic heat production and WBGT exposures. This allowed for the subsequent development of maximum heat exposure limits which were described by a family of six curves that fit power regression equations. Figure 3-9 illustrates the six major PHEL curves.

(b) ***Time Weighted Mean Metabolic Rates (twin).*** The "time-weighted-mean" (Twin) concept must be applied in unique situations not addressed as part of Physiological Heat Exposure Limits (PHEL) for shipboard applications. PHEL Curve Selection Tables for shipboard applications have taken into account the various work rates of personnel during various types of and lengths of time each activity is performed (normal watch, casualty control exercise and repair involving heavy work), therefore, do not apply the Twm concept to those situations. In cases where new or additional Twm situations occur it is essential to determine both the Twm Metabolic Rate, and may be necessary to determine the

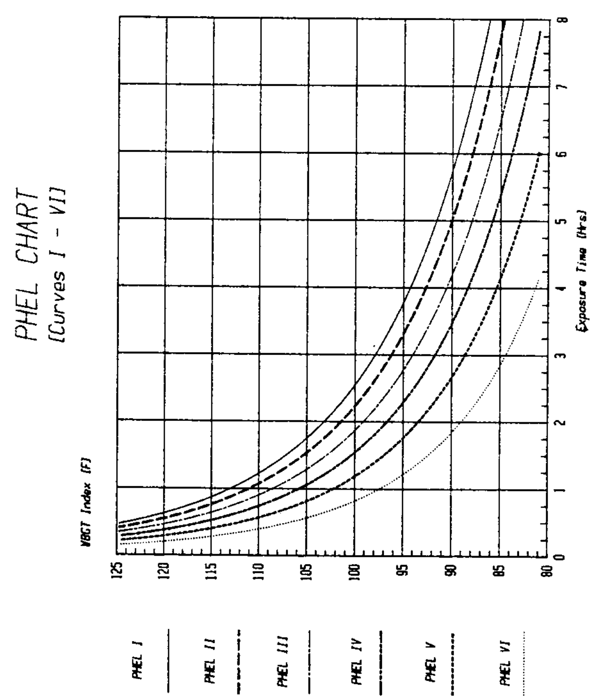


Figure 3-9.

Twm WBGT value and calculate the Twm PHEL Specific value.

(c) Procedure for Time-Weighted-Mean Applications:

1. Identify the metabolic rates (MR) for each segment of the total time under consideration, using Table 3-5.
2. ***Calculation of Twm Metabolic Rate***

Twm MR = [(MR1 * tl) + (MR2 * t2) + . . . + (MRn * tn)] / [tl + t2 + . . . + tn)]

where;

Twm MR = time-weighted-mean metabolic rate ($KCal*m^{-2}*hr^{-1}$)
MR1 = metabolic rate ($Kcal*m^{-2}*hr^{-1}$) work for exposure time #1
tl = length of time (in decimal hours) for MR1
MR2 = metabolic rate ($Kcal*m^{-2}*hr^{-1}$) work for exposure time #2
t2 = length of time (in decimal hours) for MR2
MRn = metabolic rate ($Kcal*m^{-2}*hr^{-1}$) work for exposure time #n
tn = length of time (in decimal hours) for MRn

3. ***Relationship of Twm Metabolic Rates to PHEL Curves***
4. ***Identification Of Appropriate WBGT Curves*** If the Twm MR from #2 above is close to a Twm MR in #3 above, then proceed with Table 3-8 below in selecting the appropriate PHEL Curve:
5. ***Determination of Twm WBGT*** Determine WBGT values for each of the locations were the Twm Metabolic Rates apply. Then apply the WBGT values and times for the respective Twm Metabolic Rates to the equation given in Step #6 below.
6. ***Calculation of Twm WBGT Values***

Twm WBGT = [(WBGT1 * tl) + (WBGT2 * t2) + . . . + (WBGTn * tn)] / [tl + t2 + . . . +tn)]

where;

Twm WBGT = time-weighted-mean WBGT Index degrees F
WBGT1 = WBGT at time #1
tl = length of time (in decimal hours) for WBGT1
WBGT2 = WBGT at time #2
t2 = length of time (in decimal hours) for WBGT2

Table 3-7

PHEL Curve	Twm Metabolic Rate
I	76
II	86
111	96
Iv	106
v	116
VI	126

Table 3-8

Type of Physical Activity	PHEL Curve Selection Tables For No. Minutes Work vs. No. Minutes Rest				
	50/10	40/20	30/30	20/40	10/50
Sitting					
Moderate arm & trunk movement	I	I	I	I	I
Moderate arm & leg movement	I	I	I	I	I
Heavy arm & leg movement	III	II	I	I	I
Standing					
Light work at machine or bench, mostly arms	I	I	I	I	I
Light work at machine or bench, some walking about	III	II	I	I	I
Moderate work at machine or bench, some walking about	VI	III	II	I	I
Walking About, with Moderate Lifting or Pushing	(NA)	VI	IV	III	I
Intermittent Heavy Lifting, Pushing or Pulling	(NA)	(NA)	(NA)	V	II
Hardest Sustained Work					
Lowest Metabolic Rate	(NA)	(NA)	(NA)	VI	III
Average & High Metabolic Rate	(NA)	(NA)	(NA)	(NA)	III

NOTES:

1. Do Not Attempt To Apply The PHEL Curves and/or Work Rates In Those Situations Indicated As "NA" (Not Applicable) Above. If the amount of work is underestimated it is likely that personnel systemic heat injuries will be incurred.
2. If the types of physical activity are more mixed than noted above, then there is no alternative but to resort to calculations using the TWM concept.
3. TWM metabolic rate calculations require restarting with Step #l above and selecting the metabolic activity for the specific type of work given above, as well as the length of time that applies to the selected metabolic rate situation. Then apply the selected metabolic rate and time values to the below calculations. Do likewise for the WBGT and respective time values.

WBGTn = WBGT for exposure time #n
tn = length of time (in decimal hours) for WBGTn

7. ***Calculation of Twm Approximated PHEL Values***
Twm Approximated PHEL = Antilog [(1/0. 13) * (A-Log Twm WBGT)] = hours
A = Log [111.0461 + (0.2377 * Twm MR) – (0.0027 * Twm MR^2)] WBGT = degrees F
PHEL values greater than 8 hours should be read as " >8 hours" for the upper limits.

8. ***Reduction of PHEL Times Due to Fuel Combustion Gases and/or Pre-Combustion Fuel Vapors***
PHEL times (hours) must be reduced by 65.6070 when there is the presence of fuel combustion gases and/or pre-combustion fuel vapors.

(d) ***Relationships of PHEL Curves to Rest/Work Ratios.*** The laboratory data which led to the generation of the PHEL curves allowed for the development of a related series of rest/work ratios for different degrees of physical activity. These relationships are illustrated in Table 3-8 above.

(e) ***Precautions.*** It must be emphasized that the Physiological Heat Exposure Limits are ***maximum*** allowable standards and that they should be applied only in cases of short-term work exposures of up to 8 hours duration. The limits presume that no prior heat injury is present and that no cumulative heat fatigue exists prior to re-exposure.

(9) ***Other Indices.*** Other indices of heat stress and strain are available but are of limited use. The value of any index is dependent upon the nature and extent of the problem, the availability of resources, and the experience of local personnel in regard to heat stress analyses. Consultation will be provided to commands if inquiries are directed to the Naval Medical Command through official channels.

(10) ***Information Regarding the "Wet Globe Temperature" (WGT) Index.*** The WGT Index ("Botsball") has been used in a number of situations, however, it is not appropriate to utilize the WGT to determine Physiological Heat Exposure Limits. Army meteorological studies have shown that in identically the same environmental conditions no two WGT thermometers indicated the same value, there was a marked bleaching of the black cloth coverings after one month in use, the cloth coverings had various degrees of bristle formations, the coverings occasionally did not wet uniformly, the water reservoirs frequently need refilling at one hour intervals, WGT units required at least 5 minutes of stabilization after replenishing water in the reservoir, and the WGT values do not permit availability of essential data (dry- and wet-bulb and globe temperatures) for thermal analyses. Since 1971 there have been 8 equations published that claim to permit conversion of WGT values to WBGT values, there is a tremendous disparity between the products from these equations. Application of available data, with and without conversion to estimated WBGT values, to the PHEL chart has yielded unrealistic safe exposure times. There have been similar unacceptable findings regarding the use of WGT values for estimating the amount of water needed when personnel perform work. Use of the WGT units may be expedient but application of the WGT values has extremely limited value. NAVMEDCOM has not approved the use of the WGT ("Botsball") units.

(11) ***Predicting Onset Of Mental Impairment Due To Heat Stress.*** In 1972 the Department of Health, Education and Welfare (HSM 72-10269, 1972, pg 188) published a curve entitled "Upper Limits of Exposure for Unimpaired Mental Performance". Figure 3-10 illustrates the curves for detectable onset of mental impairment as a function of the same metabolic rates for the PHEL curves; the decrements of cardiovascular reserve also have been taken into account. It is readily apparent, by comparing Figure 3-9 (in Article 3-12) with Figure 3-10, that mental impairment begins much earlier and at lower heat stress conditions than persons reaching their physiological exposure limits. In heat stress conditions it can be expected that mental acuity will have been impaired long before workers reach their physiological limits, physical performance decays in a similar fashion as that shown for mental impairment but in a different time frame.

3-13. Practical Heat Stress Standards

(1) ***General.*** Sound health, physical conditioning for the specific task, and adequate rest and nutrition are essential in minimizing the effects of thermal stress. Drinking water should be unrestricted and readily available. Threshold WBGT values for the hottest 2-hour

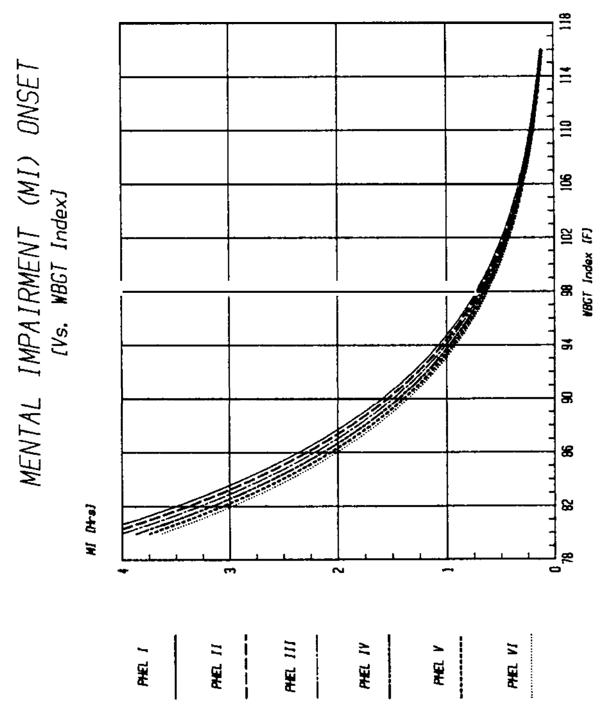


Figure 3-10.

period of *industrial-type work shifts* should be determined using the work load of personnel as described in Section 3-8 and Table 3-5. The threshold WBGT values versus work levels are repeated below:

Work Level	WBGT (F)
Light	86
Moderate	82
Heavy	

(2) ***Limitations on Physical Exertion.*** During the first 12 weeks of hot weather training the limits of physical exertion should be determined by the degree of environmental heat stress, metabolic heat production, the status of acclimatization, and the physical status of individual personnel. The availability of adequate drinking water and the frequency of rest periods should also receive consideration. Individuals who are over 35 years of age, those who are obese or whose nutritional status is poor, and those with evidence of chronic or acute cardiopulmonary dysfunction should be medically screen *prior to* physical exertion under thermal stress. Table 3-9 outlines the recommendations for different physical activities at five WBGT Index ranges. It applies especially to personnel during training and recreational exercises in hot weather. *The below table is not a substitute for the PHEL curves nor is it possible to comply with the table in combat situations.*

(3) Heating Standards.

(a) ***Surface Vessels.*** The recommended standards for heating *aboard surface vessels* imply an optimum dry-bulb temperature of 70 F for the following spaces:

(1) Living compartments, recreation and messing spaces.

(2) Medical and dental spaces.

(3) Office and control spaces.

Humidity control is not usually provided. Special requirements should be reviewed by the Medical Department before any action is taken.

(b) ***Submarines.*** Aboard submarines environmental conditions are more closely controlled. Heating standards should fall within the optimal limits of 79 F DB, 59 F WB, 50% RI-I with 63 F WBGT. These standards apply to:

(1) Living compartments, recreation and messing spaces.

(2) Medical and dental spaces.

(3) Office and control spaces.

(c) ***Other Compartments.*** Excluding the above noted spaces and those associated with engineering propulsion components, inside working spaces are usually maintained at lower temperatures during the winter. In these spaces, the control of personal warmth is facilitated by the proper use of available clothing.

(4) ***Ventilation and Air-Conditioning***

(a) ***Surface Vessels.*** Ventilation and air-conditioning standards for surface vessels should include the following upper limits for physical comfort and functional well-being: 80 F DB, 68 F WB, 55070 RH (14.3 Torr VP), with 72 F WBGT Index. The recommendations appIy to the same spaces noted for the heating standards above. In addition, air-conditioning and ventilation are required for manned electronics spaces and compartments with equipment sensitive to changes in temperature and humidity.

(b) ***Submarines.*** The standards for comparable spaces aboard submarines are as follows: 80 F DB, 67 F WB, 50% RH, with 71 F WBGT.

(c) ***Other Compartments.*** Laundries, galleys, sculleries, passages not opening directly on weather decks, and areas above food serving lines present situations in which it is difficult to contain heat and humidity within specific narrow limits. Standards for these areas, however, should allow for physical health and well-being; the WBGT Index should not exceed 78 F during normal operations. In addition, ventilation and cooling of such spaces should be consistent with the information given in Articles 3-6 and 3-7 (Section H) and Article 3-11 (Section IV) of this chapter. Design criteria presented in Table 3-1 (Article 3-7, Section 11) must be considered in planning ventilation for firerooms, engine rooms, laundries, sculleries, galleys and steam catapult launch con-

Table 3-9. WBGT as a Guide in Regulating Intensity of Physical Exertion During First 12 Training Weeks in Hot Weather*

WBGT Index [F]	Flag color	Intensity of Physical Exercise
Less Than 82	Blue	Extremely intense physical exertion may precipitate heat exhaustion or heat stroke, therefore, caution should be taken.
82-84.9	Green	Discretion required in planning heavy exercise for unseasoned personnel. This is a marginal heat stress limit for all personnel.
85-87.9	Amber	Strenuous exercise and activity (e.g., close order drill) should be curtailed for new and unseasoned personnel during the first 3 weeks of heat exposure.
88-88.9	Red	Strenuous exercise curtailed *for all personnel with less than 12 weeks training* in hot weather.
90 and Above	Black	Physical training and strenuous exercise suspended *for all personnel* (excludes operational commitment not for training purposes).

* *This table must not be used in lieu of the Physiological Heat Exposure Limits (PHEL).* The time-weighted-mean metabolic rates applicable to Table 3-8 are considerably higher than those for PHEL Curves. For an analogy, Table 3-8 would apply to Marine Corps personnel in the field, whereas the PHEL concept applies to industrial settings.

trol rooms. In situations where the heat stress is excessive and ventilation or cooling cannot be improved, the Physiological Heat Exposure Limits need to be employed to minimize the incidence of personnel heat injuries.

(5) ***Shipboard Heat Stress Situations***

(a) ***Physiological Heat Exposure Limits (PHEL) Chart.*** The PHEL chart illustrated in Figure 3-9 (Article 3-12) provides the relationships of various metabolic rates, heat stress and maximum safe exposure times. Applicability of PHEL curves to routine watches and casualty control exercises are given in Table 3-10 below, and the PHEL times for Figure 3-9 and Table 3-10 PHEL curves are given in Table 3-11; where there is no apparent presence of fuel combustion gases (or "stack gas") and/or fuel vapors. In all given situations the Twm metabolic rates have been utilized, whereby the varied activities (including movements about the spaces) and lengths of time for the various activities have been taken into account. For *Remaining Safe Stay Time* situations, where different heat stress conditions, actual exposure times and/or recovery times apply, see *Section (5)(b) below*. When it is apparent that fuel combustion gases (or "stack gas") and/or fuel vapors are present, use PHEL times given in Table 3-12.

Table 3-10. Physiological Heat Exposure Limit Curve General Applicability

Personnel	Routine Watch	* Casualty Control Exercise
Section 1. *Steam Propelled Ships*		
A. Fire Room:		
1. Boiler Tech. of the Watch (BTOW)	II	II
2. ABC Console Operator	I	I
3. Upper Levelman	II	III
4. Lower Levelman	III	IV
5. Burnerman	II	III
6. Messenger	III	IV
B. Engine Room: [Including Nuclear]		
I. Engineering Officer of the Watch [EOOW]	I	I
2. Machinist Mate of the Watch [MMOW]	II	III
3. Throttleman	I	I
4. Electrician Mate of the Watch [EMOWJ	I	I
5. Upper Levelman	II	III
6. Lower Levelman	II	III
7. Evaporator Watch	I	Not Applicable
8. Messenger	III	IV
C. Auxiliary Spaces [CV'S and FF 1052's]:		
1. Upper Levelman	II	II
2. Lower Levelman	II	II
D. Steam Catapult Launch Control Room:		
1. All Watch Personnel	II	II
Section 11. *Diesel Propelled Ships*		
A. Engineering Officer of the Watch [EOOW]	I	I
B. Petty Officer of the Watch [POOW]	II	III
C. Electrician Mate of the Watch [EMOW]	I	I
D. Throttleman	I	I
E. Repair Electrician	I	I
F. Ship's Service Diesel Generator Watch	I	I
G. Boiler Watch	I	1
H. Evaporator Watch	II	I
1. Oiler/Messenger	III	IV
Section III. Gas *Turbine Propelled Ships*		
A. All Engineering Watch Personnel	I	II
Section IV. *All Ships and Submarines*		
A. Engineering Casualty Control Evaluation Team [ECCET]	Not Applicable	II
B. Roving Watch Personnel	III	III
C. Laundry Personnel	III	Not Applicable
D. Scullery Personnel	V	Not Applicable
E. Galley and Food Serving Line Personnel	II	Not Applicable
F. Fleet Training Group Instructors and Other Off-Ship Engineering Observers	I	II
G. Personnel Conducting Heavy Repairs or Other Strenuous Work	VI	VI

* The work rate during Casualty Control Exercise is much less than that needed for repair involving heavy work. Different PHEL Curve selections are required for different work rates during the Exercise Phase, however, *all heavy work situations require use of PHEL Curve VI.*

(b) ***Remaining Safe Stay Times.*** There are a number of situations where it is necessary to estimate the remaining safe stay times relative to various heat stress conditions, different work levels and/or to account for recovery periods. Generally this is a complex task, however, a simplified approach is given in the below equation:

$$RSSt = [(1 - (Et - R/2)) / Atl] * At2$$

where:

Table 3-11. PHEL Time Limits for PHEL Curves I - VI Without the Presence of Fuel Combustion Gases and/or Fuel Vapors [WBGT 80.0 -125.0 F]

WBGT Index (F)	**Six** PHEL Curves (Total Exposure Times In Hours: Minutes)					
	I	II	III	IV	V	VI
80.0	>8:00	>8:00	>8:00	8:00	6:35	4:30
81.0	>8:00	>8:00	>8:00	7:45	6:00	4:05
82.0	>8:00	>8:00	8:00	7:05	5:25	3:40
83.0	>8:00	>8:00	7:45	6:25	4:55	3:20
84.0	>8:00	8:00	7:05	5:55	4:30	3:05
85.0	6:00	6:00	6:00	5:20	4:05	2:50
86.0	6:00	6:00	5:55	4:55	3:45	2:35
87.0	6:00	6:00	5:25	4:30	3:25	2:20
88.0	6:00	5:55	4:55	4:05	3:10	2:10
89.0	6:00	5:25	4:30	3:45	2:50	2:00
90.0	5:40	5:00	4:10	3:25	2:40	1:50
91.0	5:15	4:35	3:50	3:10	2:25	1:40
92.0	4:50	4:10	3:30	2:55	2:15	1:30
93.0	4:25	3:50	3:15	2:40	2:00	1:25
94.0	4:05	3:35	3:00	2:25	1:50	1:15
95.0	3:45	3:15	2:45	2:15	1:45	1:10
96.0	3:25	3:00	2:30	2:05	1:35	1:05
97.0	3:10	2:45	2:20	1:55	1:25	1:00
98.0	2:55	2:35	2:10	1:45	1:20	0:55
99.0	2:40	2:20	2:00	1:40	1:15	0:50
100.0	2:30	2:10	1:50	1:30	1:10	0:45
101.0	2:20	2:00	1:40	1:25	1:05	0:45
102.0	2:10	1:50	1:35	1:15	1:00	0:40
103.0	2:00	1:45	1:25	1:10	0:55	0:35
104.0	1:50	1:35	1:20	1:05	0:50	0:35
105.0	1:40	1:30	1:15	1:00	0:45	0:30
106.0	1:35	1:25	1:10	0:55	0:45	0:30
107.0	1:30	1:15	1:05	0:50	0:40	0:25
108.0	1:20	1:10	1:00	0:50	0:35	0:25
109.0	1:15	1:05	0:55	0:45	0:35	0:25
110.0	1:10	1:00	0:50	0:40	0:30	0:20
111.0	1:05	1:00	0:50	0:40	0:30	0:20
112.0	1:00	0:55	0:45	0:35	0:25	0:20
113.0	0:55	0:55	0:40	0:35	0:25	0:15
114.0	0:55	0:45	0:40	0:30	0:25	0:15
115.0	0:50	0:45	0:35	0:30	0:20	0:15
116.0	0:45	0:40	0:35	0:25	0:20	0:15
117.0	0:45	0:40	0:30	0:25	0:20	0:10
118.0	0:40	0:35	0:30	0:25	0:15	0:10
119.0	0:35	0:35	0:25	0:20	0:15	0:10
120.0	0:35	0:30	0:25	0:20	0:15	0:10
121.0	0:35	0:30	0:25	0:20	0:15	0:10
122.0	0:30	0:25	0:20	0:15	0:15	0:10
123.0	0:30	0:25	0:20	0:15	0:10	0:10
124.0	0:25	0:25	0:20	0:15	0:10	0:05
125.0	0:25	0:20	0:20	0:15	0:10	0:05

RSST = remaining safe stay time (in minutes)
Et = elapsed time on station (in minutes)
R = recovery time in a cool environment (in minutes)
Atl = allowed PHEL time in first environment (in minutes)
At2 = allowed PHEL time in second environment (in minutes)

Four examples will help illustrate the importance of calculating Remaining Safe Stay Times:

1. The level of physical work was changed from heavy to light work and the heat stress is higher in the light work phase, the elapse time of the first exposure is known, and no recovery is permitted between the two levels of physical work.
   a. Elapsed exposure time in the first heat stress condition was 3 hours (180 minutes).
   b. The first heat stress condition had a WBGT of 83.0 F and work was consistent with PHEL Curve VI. [PHEL VI at 83.0 F permits a maximum of 3 hours 20 minutes (200 minutes)]
   c. There was no recovery in a cool environment between the first environment and the second (WBGT 94.3 with work equal to PHEL Curve I). [PHEL I at 94.3 F permits a maximum of 4 hours (240 minutes).]

   Therefore, RSSt#l = [(1 – (180 – (0/2))/ 200] * 240 = 24 minutes. The second exposure situation should not exceed 24 minutes.
2. The level of physical work was unchanged at the same heat stress level but the two exposures were separated by a 40 minute recovery period in a cool environment; the elapsed time was known for the first exposure.
   a. Elapsed exposure time in the first heat stress condition was 3 hours (180 minutes).
   b. Both heat stress conditions had WBGT values of 91.3 F and the level of work was consistent to PHEL Curve I in both cases. [PHEL I at 91.3 F permits a maximum of 5 hours 8 minutes (308 minutes) each]
   c. Recovery, between the two exposures, was permitted for 40 minutes.

   Therefore, RSSt#2 = [(1 - (180 - (40/2))/ 308] * 308 = 148 minutes or 2 hours 28 minutes. The second exposure situation should not exceed 2 hours 28 minutes.
3. The level of physical work was the same in two different heat stress environments, the exposure time in the first condition was known, and the two exposures were separated by a 40 minute recovery in a cool environment.
   a. Elapsed exposure time in the first heat stress condition was 3 hours (180 minutes).
   b. The first heat stress condition had a WBGT of 91.3 F and work equalled that for PHEL Curve I. [PHEL I at 91.3 F permits a maximum of 5 hours 8 minutes (308 minutes)]
   c. There was 40 minutes recovery in a cool envi-

ronment between the first environmental exposure, and the second exposure at a WBGT of 94.3 F with work equivalent to PHEL Curve I. [PHEL Curve I at WBGT of 94.3 F permits 4 hours (240 minutes) stay time]

Therefore, RSSt#3 = [(1 – (180 – (40/2))/ 308] * 240 = 115 minutes or 1 hour 55 minutes. The second exposure situation should not exceed 1 hour 55 minutes.

4. The level of physical work changed from an intermediate level to lighter level and the heat stress was considerably higher in during the second exposure. Both the elapsed time for the first exposure and the recovery time between exposures were known.
   a. Elapsed exposure time in the first heat stress condition was 3 hours 15 minutes (195 minutes)
   b. The first heat stress condition had a WBGT of 87.7 F and work was consistent with PHEL Curve IV. [PHEL IV at 87.7 F permits a maximum of 4 hours 15 minutes (255 minutes)]
   c. There was 50 minutes recovery in a cool environment between the first exposure and the second, the work during the second exposure was equivalent to PHEL Curve II, but the WBGT value was 100.9 F for the second exposure. [PHEL 11 at 100.9 F allows a maximum of 2 hours 5 minutes (125 minutes)]

Therefore, RSSt#4 = [(1 – (195 – (50/2))/ 255] * 125 = 42 minutes. The second exposure situation should not exceed 42 minutes.

NOTE: *In application of the Remaining Safe Stay Time equation it must be acknowledged that some cumulative fatigue will take place.*

(c) Presence of Fuel Combustion Gases and/or Fuel Vapors. As indicated in Article 3-11(3), the apparent presence of fuel combustion gases (or "stack gas") and/or fuel vapors has a deleterious impact upon workers. To minimize excessive exposures it is possible to utilize the PHEL Curves provided the stay times are reduced 66%. *Table 3-12 provides the reduced PHEL values* compared with those given in Table 3-11.

(d) ***Alternative Options for Regulating Heat Stress.*** It is sometimes impossible to control environmental heat within the specified limits in the face of increased operational demands. Alternative measures may therefore be useful in limiting heat stress and reducing the incidence of heat casualties. Several options are possible:

(1) Insulate the source of heat.

(2) Ventilation with cool air (Section II of this chapter).

(3) Reduce humidity (partial water vapor content) by stopping steam leaks and venting steam to the outside.

(4) Provide clothing which will maximize evaporative cooling.

(5) Limit exposure time (refer to PHEL Chart).

(6) Avoid cumulative fatigue; maintain overall physical health.

(7) Eliminate the presence of fuel combustion gases and fuel vapors.

(8) Automate and isolate operations which generate excessive heat (not always feasible).

(6) ***Compressed Air and Vortex Cooling.*** Compressed air and vortex-type cooling methods present individualized assets and liabilities. Plans to utilize these techniques should be reviewed by the Naval Medical Command *prior to their operation/ use.* The subjective sense of well-being afforded by these methods is not always synonymous with the maintenance of object physiologic

Table 3-12. PHEL Time Limits for PHEL Curves I - VI With the Presence of Fuel Combustion Gases and/or Fuel Vapors [WBGT 80.0-115.0 F]

WBGT Index (F)	Six PHEL Curves (Total Exposure Times In Hours: Minutes)					
	I	II	III	IV	V	VI
80.0	*4:50*	4:15	3:30	2:55	2:15	1:30
81.0	*4:25*	3:50	3:10	2:40	2:00	1:20
82.0	*4:00*	3:30	2:55	2:25	1:50	1:15
83.0	*3:40*	3:10	2:40	2:10	1:40	1:10
84.0	*3:20*	2:55	2:25	2:00	1:30	1:00
85.0	*3:00*	2:40	2:10	1:50	1:25	0:55
86.0	*2:45*	2:25	2:00	1:40	1:15	0:50
87.0	*2:30*	2:10	1:50	1:30	1:10	0:45
88.0	*2:20*	2:00	1:40	1:25	1:05	0:40
89.0	*2:05*	1:50	1:30	1:15	1:00	0:40
90.0	*1:55*	1:40	1:25	1:10	0:55	0:35
91.0	*1:45*	1:30	1:15	1:05	0:50	0:30
92.0	*1:35*	1:25	1:10	1:00	0:45	0:30
93.0	1:30	1:20	1:05	0:55	0:40	0:25
94.0	1:20	1:10	1:00	0:50	0:35	0:25
95.0	*1:15*	1:05	0:55	0:45	0:35	0:20
96.0	1:10	1:00	0:50	0:40	0:30	0:20
97.0	1:05	0:55	0:45	0:40	0:30	0:20
98.0	1:00	0:50	0:40	0:35	0:25	0:15
99.0	0:55	0:45	0:40	0:30	0:25	0:15
100.0	0:50	0:45	0:35	0:30	0:20	0:15
101.0	0:45	0:40	0:35	0:25	0:20	0:15
102.0	0:40	0:35	0:30	0:25	0:20	0:10
103.0	0:40	0:35	0:30	0:25	0:15	0:10
104.0	0:35	0:30	0:25	0:20	0:15	0:10
105.0	0:35	0:30	0:25	0:20	0:15	0:10
106.0	0:30	0:25	0:20	0:20	0:15	0:10
107.0	0:30	0:25	0:20	0:15	0:10	0:10
108.0	0:25	0:25	0:20	0:15	0:10	0:05
109.0	0:25	0:20	0:15	0:15	0:10	0:05
110.0	0:25	0:20	0:15	0:15	0:10	0:05
111.0	0:20	0:20	0:15	0:10	0:10	0:05
112.0	0:20	0:15	0:15	0:10	0:10	0:05
113.0	0:20	0:15	0:15	0:10	0:05	0:05
114.0	0:15	0:15	0:10	0:10	0:05	0:05
115.0	0:15	0:15	0:10	0:10	0:05	0:05

well-being. Furthermore, there is a need to ensure that the quality of the air used in these methods meets breathing quality air standards. In describing the intended use it is essential that the potential ability to provide a continuous air supply, while man is tethered to the filtered air supply outlet, is a reality. Commonly available vortex tubes have no means of ensuring the maximum cooling fraction setting, therefore, it is necessary to describe the positive means of controlling the cooling fraction and locking the control knob in the optimum cooling fraction position (which is rarely at the fully open setting on the vortex tube control valve). Fractional distribution of "cooling" air over the body surface needs to be proportional to that surface area of the body and active muscle sites involved in performing the intended physical work.

(7) ***Other Body Cooling Devices/Attempts.*** Comprehensive physiological and environmental information available to date has not supported the use of liquid cooling, solid carbon dioxide vests, or other such garments worn under regular work clothing in terms of economics, unrestricted body movement, and optimum safety of personnel in shipboard non-emergency situations. There may be highly specialized applications of such units, but each remains to be carefully examined with sufficient supporting data. The key issue is to perform the necessary corrective engineering actions to eliminate impedances of the workers and permit the workers to perform their normal duties in an effective manner without physical encumbrances. In emergency situations, limited use of such body cooling devices may be required, however, the personnel wearing the devices must be fit individuals who are under very close supervision during the emergency events. Historically, attempts at pre-cooling deep body temperatures prior to excessive high heat stress exposures were relatively ineffective in markedly extending personnel exposure times.

3-14. Practical Cold Stress Standards

(1) ***Equivalent Temperature (Wind Chill Index).*** The human body is continually producing heat internally and losing it externally to the environment. A portion of this heat exchange is accounted for by the circulation of air at the skin surface. Increased air velocity thus proportionately increases the loss of body heat. If the ambient air temperature is below freezing and the wind velocity is such that it removes heat from the body surface more rapidly than it can be replaced, frostbite may occur. The combined effect of wind and temperature are given in the Equivalent Temperature Chart, commonly referred to as the Wind Chill Index (Table 3-13). This chart is an expression of the effective temperature acting on exposed body surfaces. In using the chart the estimated (or actual) wind velocity is compared to the dry-bulb air temperature. The equivalent temperature is found where the two columns intersect. For example, at a temperature of – 10 F under calm conditions, the equivalent temperature on exposed body surfaces is the same as that of ambient air, i.e., – 10 F. On the other hand, if the wind velocity increases to 10 miles per hour, the loss of body heat at the skin surface is equivalent to that experienced with no wind at – 33 F. For figures intermediate to those listed in Table 3-13, proportionate interpolations may be made as needed. Table 3-13 also indicates the variable dangers of the different equivalent temperatures.

(2) ***Additional Considerations Regarding Equivalent Temperature.*** It should be noted that Equivalent Tem-

Table 3-13. Cooling Power of Wind on Exposed Flesh Expressed as a Equivalent Temperature

Estimated Wind Speed (mph)	Actual Thermometer Reading (F)											
	50	40	30	20	10	0	– 10	– 20	– 30	– 40	– 50	– 60
	EQUIVALENT TEMPERATURE (F)											
Calm	50	40	30	20	10	0	– 10	– 20	– 30	– 40	– 50	– 60
5	48	37	27	16	6	– 5	– 15	– 26	– 36	– 47	– 57	– 68
10	40	28	16	4	– 9	– 24	– 33	– 46	– 58	– 70	– 83	– 95
15	36	22	9	– 5	– 18	– 32	– 45	– 58	– 72	– 85	– 99	– 112
20	32	18	4	– 10	– 25	– 39	– 53	– 67	– 82	– 96	– 110	– 124
25	30	16	0	– 15	– 29	– 44	– 59	– 74	– 88	– 104	– 118	– 133
30	28	13	– 2	– 18	– 33	– 48	– 63	– 79	– 94	– 109	– 125	– 140
35	27	11	– 4	– 21	– 35	– 51	– 67	– 82	– 98	– 113	– 129	– 145
40	26	10	– 6	– 27	– 37	– 53	– 69	– 85	– 100	– 116	– 132	– 148
(wind speeds >40 mph have very little additional effect.)	LITTLE DANGER (for properly clothed person) Maximum danger of false sense of security.				INCREASING DANGER Danger from freezing of exposed flesh.			GREAT DANGER				

Trenchfoot and immersion foot may occur at any point on this chart.

perature (Wind Chill Index) applies only to ***dry skin*** and does not take account of the effect of evaporative cooling. The insulation provided by clothing and the accentuation of heat loss by wet garments are similarly not considered. When estimating the Equivalent Temperature (Wind Chill Index) other causes of increased air circulation over the body should be noted. For instance, the estimated air speed occasioned by walking, running, or riding in an open vehicle must be added to the actual (or estimated) wind velocity when estimating the equivalent surface temperatures. Finally, it is worth remembering that regardless of the wind velocity, the danger of frostbite to ***dry*** exposed body surfaces is negligible as long as the dry-bulb air temperature is above freezing.

(3) ***Special Applications of Equivalent Temperature.*** Although the Equivalent Temperature (Wind Chill Index) can be taken as a practical cold stress standard, special situations may require referral to the Naval Medical Command, Department of the Navy, Washington, D. C., 20372–5 100, for consultation.

(4) ***Median Lethal Exposure Limits:***

(a) Frigid water triggers complex physiological responses that shut down the blood circulation to most parts of the body except heart, lungs and brain. Though the blood contains only a limited amount of oxygen, it can be enough to sustain life and prevent damage to brain tissue for considerable periods of time, once the body's internal temperature has dropped. A cooled-down brain needs less oxygen than one at normal temperature. It takes 10-15 minutes before the deep body temperatures start to drop, surface tissues cool quickly. A victim may experience labored breathing and stiffness of limbs. As core temperature drops to 95 F there will be violent shivering; at 90–95 F, mental facilities cloud; at 86-90 F there is muscular rigidity and loss of consciousness. Below 86 F there is diminished respiration and possible heart failure. Below 80 F, respiration becomes almost undetectable and death is imminent.

(b) There are five cold water immersion ***"DO's":***

1. ***Wear a personal flotation device*** (PFD) or several layers of clothing.

2. ***Try to keep lungs inflated with air*** to maintain bouyancy.

3. ***Use minimum movement*** to prevent the escape of trapped air in clothing, which acts as an insulator.

4. ***Maintain HELP*** (Heat Escape Lessening Posture) ***until help arrives.*** The HELP position is basically a fetal position with arms and legs withdrawn close to the body. ***An alternative is to huddle*** with two or more persons in the water.

5. ***Take advantage of floating objects.***

(c) There are five cold water immersion ***"DO NOT'S":***

1. Do not panic! Actions within the first 10 seconds can mean survival or death.

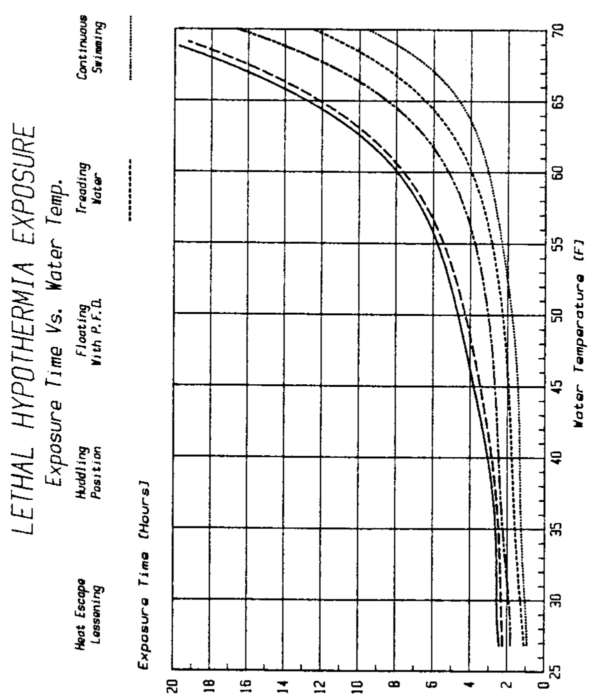
2. ***Do not strugg[e.*** Struggling will squeeze insulative air out of clothing and ingesting cold water may constrict breathing passages and induce "dry drowning. "

3. ***Do not swim for [and that's over a mile away.***

4. ***Do not remove clothing.***

5. Do not use so-called "drownproofing" techniques in water that is colder than 72 F. Drownproofing involves floating almost motionless for long periods, relying on the natural bouyancy of the body and its tendency to hand in a semi-vertical position in water, with the head just breaking the water surface. In cold water, the greatest heat loss is from the head and neck. Since drownproofing requires immersion of those areas, the onset of hypothermia, followed by death, can be brought about with distressing swiftness.

Figure 3-11 illustrates the Hypothermia Median Lethal Exposure (Survival Time Versus Water Temperature) for HELP position, huddling, normal floating with a personal flotation device, treading water and swimming. Hypothermia median lethal exposure times assume that the victim has survived the initial thermal and physical shock of entry into the water.



Bureau of
Medicine and Surgery
Washington, DC 20372-5300

NAVMED P-5010-4 (Rev. 6-2002)
0510-LP-101-3891

Manual of Naval Preventive Medicine

Chapter 4

SWIMMING POOLS AND BATHING PLACES

DISTRIBUTION STATEMENT "A"

This publication supersedes NAVMED P-5010-4 of 1990 S/N 0510-LP-206-6100

NAVMED P-5010-4

Chapter 4
Manual of Naval Preventive Medicine
Swimming Pools and Bathing Places

6 June 2002

To: Holders of the Manual of Naval Preventive Medicine

1. **Purpose**. This revision reflects the latest swimming pool and spa safety and water quality recommendations of the National Swimming Pool and Spa Institute.

2. **Action**. Replace entire chapter 4 with this version.

D. C. ARTHUR
Deputy Chief, Bureau of
Medicine and Surgery

CHAPTER 4
SWIMMING POOLS AND BATHING PLACES

CONTENTS

CHAPTER 4
SWIMMING POOLS AND BATHING PLACES

TABLES **Page**

FIGURE

Section I. GENERAL INFORMATION

4-1. INTRODUCTION. This chapter is provided for guidance of Medical Department personnel concerned with sanitary controls, surveys, and inspections of all U.S. Navy and Marine Corps bathing and water training facilities, both artificial and natural, including over-the-side swimming. Other Department of the Navy personnel, both civilian and military, may use this publication as a guide for sanitary standards in the safe operation of training/swimming pools and other bathing facilities. Saunas and steam rooms are addressed in Chapter 2 of this manual, (NAVMED P-5010-2, Sanitation of Living Spaces and Related Service Facilities).

4-2. RESPONSIBILITY

a. The Bureau of Naval Personnel is responsible for supervision, policy guidance, technical, and administrative direction of the Navy-wide Recreational Services Program, which include pool and inland/surf beach operations.

b. The Chief, Bureau of Medicine and Surgery (BUMED) is responsible for developing and promulgating health standards to protect the health and well being of Navy and Marine Corps personnel.

c. The Naval Facilities Engineering Command (NAVFACENGCOM) is responsible for design, construction drawings and specifications, construction, major repairs, and maintenance standards for pools and bathing places.

d. The commanding officer is responsible for the operation of swimming and bathing places; however, this responsibility is normally delegated as follows:

(1) The recreation director is assigned responsibility for management and operation of all recreational bathing facilities, both artificial and natural. This includes the proper selection and training of personnel.

(2) The cognizant medical authority (preventive medicine authority) is responsible for vigilant surveillance of those aspects of operations, maintenance, and laboratory practice that pertain to health protection, and for making pertinent recommendations to the commanding officer. He should review all plans for new and renovated pools and natural bathing areas.

(3) The public works officer is responsible for the maintenance of all swimming pool facilities. Additionally, he is responsible for assuring that bacteriological and chemical analyses of pool water are performed by an acceptable water laboratory. MIL-HDBK-1190, Facility Planning and Design Guide and MIL-HDBK-1037/1, (publication pending) Training and Recreation Pools provides guidance.

4-3. DEFINITIONS. The following definitions of words and terms apply in the interpretation of this chapter:

a. **Air Gap.** A physical separation sufficient to prevent backflow between the free-flowing discharge end of the potable water and any other system. An air gap is physically defined as a distance equal to twice the diameter of the supply side pipe, but never less than 1 inch.

b. **Alkalinity.** The amount of alkaline compounds (e.g., carbonate, bicarbonate) present in the pool water for the purpose of functioning as a buffer.

c. **Alum.** A fine, white, powdered aluminum sulfate compound, which when added to water, produces a flocculate of settleable particles which can be removed by filtration.

d. **Anthracite (Anthrafilt).** A hard, finely ground coal used as a swimming pool filter medium.

e. **Appurtenances.** Equipment components of the circulation system of a swimming pool.

f. **Backsiphonage.** Backflow resulting from negative pressure in the distribution pipes of a potable water supply.

g. **Backwash.** A procedure for cleaning swimming pool filters by reversing the flow of water through the filter, which removes the trapped solid matter from the filter medium. When authorized, the waste is discharged to the sewer drain.

h. **Buffer.** A chemical compound that resists changes in the acidity/alkalinity of the pool water by neutralizing acids and bases.

i. **Chlorine Residual.** The amount of chlorine remaining in the pool water after the chlorine demand (oxidation of organic compounds) is satisfied. The combined residual is the portion which reacted with nitrogen compounds (e.g., ammonia) to form chloramines. Free chlorine residual is the portion remaining available for rapid disinfection.

j. **Cross-Connection.** Any actual or potential connection between the public water supply and a source of contamination or pollution.

k. **Cyanuric Acid ($C_3N_3(OH)_3$).** A compound added to pool water to stabilize the chlorine from rapid decomposition by the ultraviolet rays of sunlight.

l. **Diatomaceous Earth.** A white powder composed of the fossilized skeletons of one-celled diatoms and used as a filter medium in some swimming pools.

m. **D.P.D.** The chemical diethyl-p-phenylene diamine, in tablet form, is commonly used in a colorimeter type water test kit for the measurement of chlorine residuals.

n. **Encrustation.** A crust, hard layer or coating.

o. **Filtration.** The process of removing suspended particles from the pool by circulating the water through a filtering medium.

p. **Flocculant.** A compound (e.g., aluminum sulfate) which, when added to water, causes suspended particulates to clump together, forming larger particles that can be readily removed by filtration.

q. **Flood-Level Rim.** The edge of the receptacle from which water overflows.

r. **Free Available Chlorine (FAC).** The portion of the chlorine residual in water that is available for immediate oxidation (destruction) of bacteria and contaminants.

s. **Interceptor (Hair Strainer).** A device placed ahead of the pump to prevent hair, lint, or paper debris from clogging the pump mechanism.

t. **Muriatic Acid (Hydrochloric Acid).** This chemical is used to reduce excess alkalinity in pool water.

u. **pH.** The relative degree of acidity or alkalinity of water as indicated by the hydrogen-ion concentration. An acid-base scale (pH) is used; 0 to 6.9 is acidic, 7.0 is neutral, and 7.1 to 14.0 is basic.

v. **Precipitate.** An insoluble compound formed by chemical action between two or more normally soluble compounds in solution (e.g., the addition of chlorine to a pool containing dissolved iron will cause a reddish precipitate of insoluble iron compounds).

w. **Skimmer.** A device other than a gutter that is an integral component of the recirculation system. The device continually removes floating debris and is designed to handle up to 80 percent of the recirculated pool water.

x. **Slurry Feeder.** A device designed to introduce or "feed" a slurry of chemicals (e.g., soda ash, alum) into the pool without clogging.

y. **Soda Ash.** Sodium carbonate (Na_2CO_3). A dry compound used to increase pH and total alkalinity in pool water. It neutralizes hydrochloric acid (HCL) produced from chlorination and results in an increase of the pH.

z. **Sodium Bisulfate.** A chemical ($NaHSO_4$) which produces a mild acid solution. Used in swimming pool water to lower the pH.

aa. **Superchlorination.** The application of a high level of chlorine (5-10 ppm FAC) for the purpose of "burning off" or oxidizing accumulated organic matter and controlling algae.

bb. **Surge Tank.** A tank used to collect overflow water from the pool, which can be used to add "make-up" water to the pool.

cc. **Turbidity.** Degree to which suspended particles in pool water obscure visibility. Usually a cloudy or hazy appearance in pool water caused by finely divided particles suspended in water.

dd. **Turn Over.** The number of times per day the water capacity of the pool is circulated through the filter.

4-4. HEALTH HAZARDS IN SWIMMING POOLS AND BATHING FACILITIES

a. There is little epidemiological evidence that a well-run pool will become a health hazard; however, water may harbor parasites and pathogens that can cause infection or disease in humans. Examples include leptospirosis, schistosomiasis, cholera, and pfiesteria.

b. **Types of Hazards**

(1) **Mechanical.** Slippery surfaces, projecting objects, floating or underwater obstructions, inadequate depth for diving, sudden changes in depth, loose/missing drain covers, inaccessible and unmarked master cutoff switch for pump, improper or illegible depth markings, insufficient lighting, and turbid water.

(2) **Electrical.** Wiring, lights, and appliances are particularly dangerous near water.

(3) **Practices of Swimmers.** Overexertion, swimming with physical impairment or under medication or alcohol consumption which limits swimming ability, hyperventilation and extended breath-holding, overexposure to sun, wind, or water, swimming during thunderstorms, swimming too soon after eating, rough play, and swimming beyond limits.

(4) **Marine.** Predatory fish, especially sharks; fish with dangerous mechanisms of defense, such as the Portuguese man-of-war and the sting ray; undertow, strong current, sharp coral reefs, and discarded debris, i.e., cans and broken glass.

SECTION II. CONSTRUCTION, OPERATION, AND INSPECTION OF SWIMMING/TRAINING POOLS AND BATHHOUSES

4-5. WATER QUALITY. The water source for swimming pools should be from a community potable water system. Wells or other sources of water used solely for an individual pool must be approved by the local preventive medicine authority.

4-6. TYPES OF SWIMMING POOLS

a. **Recirculated Pool.** This is the only type of pool normally approved for construction. The same water is continuously filtered and disinfected to provide a safe water quality for swimmers. The principles involved in a sanitary recirculated pool are discussed in this chapter.

b. **Wading Pools and Splash Pads**

(1) **Wading Pools.** A wading pool is an artificial pool with a maximum depth of 24 inches (61 centimeters (cm)) intended for use by children. The probability of acquiring infection from a wading pool is greater than from large pools because young children are more likely than adults to contaminate and drink the waters. Wading pools are usually small, and should be constructed of the same material as the main pool. These pools should have a continuous inflow of treated water to give a complete water change every hour. Overflow should be of the open type, extend completely around the pool and should be handled by a separate filtration system, apart from the main pool's filtration system. Careful consideration must be given to assure adequate distribution of the treated water and provide the necessary recirculation. It is generally recommended that wading pools be converted to splash pads which are easier to operate in a sanitary manner.

(2) **Splash Pads.** These are artificial pools for use by children. Treated water is sprayed into the pool and runs to waste or is returned to a separate filtration system, apart from the main pool's filtration system.

4-7. POOL LOCATION. Swimming pools should be located to prevent storm and other surface drainage from entering the pool. The deck should be well above the ground level and located at a site where dirt, dust, and debris will not be carried or blown into the pool. Trees and shrubbery may enhance the appearance of a pool, but they should be located so leaves and other organic material do not fall into the water.
The pool area should be enclosed by a fence or wall no less than 7 feet (2.1m) high and preferably 8 feet (2.4m) high. The gate(s) must be locked closed when the pool is not in use.

All new or renovated pools should be provided with bathhouses. The bathhouse should be located to provide a windbreak from prevailing winds. Some pools located near living quarters where dressing, shower, and toilet facilities are available, are not required to have a bathhouse. In these instances, the pool should be provided with outdoor showers, where swimmers will be required to shower before entering the pool area. If a spectator area is provided, it should be separate and distinct from the bath area with separate entrances.

4-8. CONSTRUCTION AND DESIGN

a. **Materials.** Swimming pools and appurtenances should be constructed of materials which are inert, nontoxic, impervious, permanent, and can withstand design stresses. Pools should be finished in white or light colors (e.g., light blue, blue-green, or turquoise) and should be smooth. Earth or sand bottoms are not permitted. Swimming pools must be designed to make supervision of swimmers easy.

b. **Size and Depth**

(1) All pools must be designed and constructed to withstand anticipated loads for both full and empty conditions, and a pressure relief valve must be provided to relieve pressure caused by hydrostatic head when the pool is empty.

(2) The minimum water depth in the shallow end of the pool should be 3 feet (90 cm) deep, except in special purpose, competitive, or training pools. Areas less than 3 feet (90 cm) should be separate from the main pool and considered as wading pools.

c. **Bottom and Sidewalls**

(1) Where water depth is less than 5 ½ feet (1.7 meters), the pool bottom slope must be a maximum of 1 inch per foot (2.5 cm per 30 cm). Sudden slope changes or flat areas are prohibited. In pools less than 50 feet (15 m) overall length, the rate of the slope may be increased to 1 ½ inches per foot (3.8 cm per 30 cm).

(2) Where water depth is greater than 6 feet (1.8 m) the slope should not exceed 1 foot in 3 feet (30 cm in 90 cm).

(3) If safety ledges are provided on vertical walls in deep portions of the pool they should not be over 4 to 6 inches (10 to 15 cm) wide and be at least 4 feet (1.2 m) below the water surface with a slope of one-half inch in 4 inches (1.3 cm to 10 cm) toward the pool.

d. **Ladders and Handrails.** Ladders should be provided at the shallow end of the pool and on each side at the deep end of the pool. Normally a mode of egress is provided for each 75 feet (23 m) of pool perimeter but there should be at least three. They must be constructed of nonferrous metal, with handrails on both sides; treads must have nonslip top surfaces. Ladders should have a clearance of not more than 6 inches (15 cm) nor less than 3 inches (8 cm) between the ladder and the pool wall. Recessed stepholes or stairways built out from the wall are prohibited. Handrails should be provided for all steps and ladders leading to diving boards more than 3 feet 4 inches (1 m) above the water. Diving platforms over 3 feet 4 inches (1 m) high should be protected with guardrails.

e. **Deck and Adjacent Area.** The deck areas of indoor pools must completely surround the pool, and be 12 feet (3.6 m) wide, except 15 feet (4.5 m) is required at the diving board end only. The minimum deck width for outdoor pools is 15 feet (4.5 m) with 20 feet (6.0 m) at the diving board end only. Deck areas must have a slope of one-eighth inch per foot (0.3 cm per 30 cm) away from the pool edge. Deck drains should be located so that one deck drain will serve a maximum of 250 square feet (23.2 square meters) of deck area. The deck must be smooth, with a nonslip surface, and easy to maintain. A curbing of nonslip material should be provided around the perimeter of a pool. Outdoor pools must be provided with a curb on the outside of the deck area to prevent litter or dirt from reaching the deck area and the pool.

f. **Markings**

(1) All variations in pool depth of 1 foot (30 cm) will be marked on the pool's deck. In the case of indoor pools, markings may also be located on the adjacent walls. For outdoor pools, depth marking may also be mounted on the perimeter fence at the edge of the deck.

(2) Swimming lane markings, of the same finish as the pool lining, should be provided on the bottom of the pool.

(3) Either the main drain should be clearly marked by laying colored tile around the drain perimeter, or the grating should be painted a conspicuous color.

g. **Diving Boards and Area**

(1) Standard diving "spring" boards are 14 to 16 feet (4.3 to 4.9 cm) long and 1.67 feet (50.9 cm) wide. The standard distance for mounting the board is 3 feet 4 inches (1 m) or 9 feet 10 inches (3 m) above the water. Diving boards should be of aluminum or fiberglass construction with a nonslip surface. All diving boards should be well anchored to the deck and should be installed with a lockable fulcrum adjustable over a distance of 10 to 12 inches (25 to 31 cm). The front end of the board must be at least 5 feet (1.5 m) beyond the pool wall for 14-foot (4.3 m) boards, and 6 feet (1.8 m) for 16-foot (4.9 m) boards.

(2) Indoor pools must be provided with at least 16 feet (5 m) of headroom above the highest diving board.

(3) The distance from the center line of diving boards to the pool side walls should be at least 12 feet (3.7 m) or 10 feet (3.1 m) clearance between diving boards.

(4) The minimum distance between diving boards, measured from the center lines, should be 12 feet (3.7 m) or 10 feet (3.1 m) clearance between diving boards.

(5) The water depth adjacent to diving boards must conform to the following safety standards:

Table 4-1. Water Depth Standards for Diving Board Safety

Elevation of diving board above water	Minimum depth of water under end of board	Minimum length of the diving well
1.6 feet (0.5 m)	9 feet (2.7 m)	25 feet (7.6 m)
3.3 feet (1.0 m)	10 feet (3.1 m)	35 feet (10.7 m)
9.8 feet (3.0 m)	12 feet (3.7 m)	40 feet (12.2 m)

h. **Military Training Platforms.** Platforms used only for military training, e.g., abandon ship drills, etc., shall be rigidly constructed, have non-slip surfaces, and be properly anchored to ensure stability. Such platforms shall have a minimum of 15 feet of unobstructed headroom. Platforms shall have a separation of 10 feet (3.1 m) horizontally between itself and other platforms and side walls. The maximum safe elevation of platforms above the surface of the water in relation to the depth of the water is given in the following table.

Table 4-2. Water Depth Standards for Military Training Platforms

Height of Platform		Minimum water depth at end of platform and 12 ft (3.7 m) beyond		Minimum pool width at end of platform and 12 ft (3.7 m) beyond	
Feet	Meters	Feet	Meters	Feet	Meters
0 - 6	0 - 1.8	8.5	2.6	20	6
6 - 10	1.8 - 3	10	3	30	9.1
More than 10	3	11.5	3.5	30	9.1

All new construction will meet these requirements. All platforms must be clearly marked: "**NOT FOR RECREATIONAL USE.**" Areas must be made *inaccessible* to recreational use. Entry to water from all platforms must be feet first. All operations will be under adequate supervision.

Note: Existing platforms that do not meet the requirements of the table above may be issued a waiver. Request waiver through BUMED providing pool dimensions, exact usage, and mishap history of pool.

i. **Water Slides.** When water slides are permitted in swimming pools, the water depth at the installation site must be at least 5 feet (1.5 m). When installed in the diving area, the distance between the water slide and a diving board must be at least 12 feet (3.7 m) from the center line of the diving board to the center line of the water slide. Headfirst slides should be prohibited and a sign with words to the effect, **"NO HEAD FIRST SLIDES"** must be posted.

j. **Chlorine Gas Room.** Cylinders containing chlorine gas shall be enclosed in a room to protect against accidental leakage. Provisions must be made in the room for securing tanks (e.g., chaining to wall or post). In all new construction the room shall be above ground. A spark-proof mechanical ventilation system capable of producing a complete exchange of air in 1 minute (60 changes per hour) must be provided. The mechanical ventilation system must exhaust from within 9 inches of the floor. It is preferred that the control for the exhaust fan operates automatically when the door in open. If the exhaust is manually operated, the switch shall be located outside the room. Any electrical switches for the control of artificial lighting and ventilation should be on the outside of the enclosure adjacent to the door. It is recommended that an automatic chlorine leak detector and alarm be installed in the chlorine room. The exit door must open to the outside and there must be at least one observation window for viewing the interior from the outside. The floor should have a non-slip finish. A potable water outlet and eyewash/deluge shower meeting the specifications of the American National Standards Institute (ANSI) Z358.1-1998 must be located in the immediate area. Additional information may be obtained from The Chlorine Institute, Inc., 2001 L Street, NW, Washington, DC 20035, (202) 775-2790 and should include a copy of the "Chlorine Manual" and the wall chart entitled "Handling Chlorine Cylinders and Ton Containers."

(1) Signs will be posted in the vicinity with the following information:

(a) If there is a chorine gas leak, immediately evacuate the area and move upwind from the leak.

(b) Do not enter the chlorine room or try to stop the leak.

(c) Fire department and other emergency telephone numbers will be posted. They should be used to immediately request help in case of a chlorine gas incident.

(2) Lifeguards and other supervisory personnel will receive indoctrination in the proper procedures to follow in case of a chlorine gas incident. The procedures will be provided in a standard operating procedures (SOP) manual.

(3) Only properly trained and equipped emergency personnel with pressure demand self-contained breathing apparatuses (SCBAs) will attempt to stop a leak.

(4) Most chlorine gas leaks can be easily repaired; however, some leaks may require the use of special clamps to seal them. Facilities in which chlorine gas cylinders are used must ensure that the fire department is properly equipped to handle incidents of this nature.

k. **Bathhouse.** MIL-HDBK-1190 provides criteria for bathhouse construction. The bathhouse should provide entrance to the pool near the shallow end and consist of dressing rooms, clothing storage facilities, toilets, and showers. Bathhouses used by both sexes should be separated by tight partitions with privacy screens placed at the entrances. Floors should be made of smooth, non-slip, and impervious material with the corners and intersections between the floors and walls rounded. All floors must have a pitch of ¼ inch/foot (0.6 cm/30 cm) and slope to drain to permit cleaning with a hose. Floors should be cleaned and disinfected daily with an approved disinfectant (e.g., 50 ppm chlorine solution). The facility should be pro-ided with natural and/or mechanical ventilation to reduce excessive heat and dampness. Fluorescent lighting designed to supply a minimum of 20-foot candles must be provided.

(1) **Dressing Rooms.** Walls and partitions should be of smooth impervious masonry construction with no open cracks or open joints. Partitions between dressing compartments should terminate 6 inches (15 cm) above the floor. Lockers, when provided, should be well ventilated, set on a closed base furnished with the locker unit, substantially anchored to the floor, and braced at the top. The lockers should be vermin proof and tightly jointed. Furniture should be simple and easily cleanable.

(2) **Plumbing Fixtures.** Hot-water showers not to exceed 100°F (38°C) with soap dispensers must be provided. A central automatic mixing valve is recommended. Drinking fountains will be the angle-jet type. Multiple hose bib connections with back flow prevention devices should be provided for ease in cleaning. Lavatories with liquid soap and paper towels or hand-drying devices will be provided. Toilet and lavatory facilities should be inspected by the pool operators every 2 hours and should be cleaned at least once a day. Separate plumbing fixtures for swimmers and spectators may be provided, as listed below in Table 4-3.

(3) **Waste Disposal**

(a) **Waste Water.** Liquid waste from the bathhouse or related facilities will be discharged to the sewage system.

(b) **Solid Waste Receptacles.** An adequate number of solid waste receptacles with self-closing lids must be located in the bathhouse, toilet, dressing rooms, and spectator areas. The receptacles will be emptied and cleaned at least daily or as necessary.

Table 4-3. Swimming Pools: Sanitary Facilities Required Based Upon User Load

Facility	Number of Swimmers		Number of Spectators	
	MALES	FEMALES	MALES	FEMALES
Water Closet	1/40	1/20	1/250	1/150
Lavatory	1/40	1/40	1/200	1/150
Urinal	1/40	-	1/250	-
Shower	1/30	1/30	-	-
Drinking Fountain	1/100	1/100	1/400	1/400

4-9. RECIRCULATION SYSTEM AND APPURTENANCES

a. **Outlets.** Water is removed from a swimming pool for treatment and recirculated through overflow gutters or skimmers and main drains. Gutters and skimmers remove oils and other floating wastes.

(1) Overflow gutters generally extend completely around the pool, and are capable of handling 50 percent of the recirculating water. The openings into the gutter usually are less than 4 inches (10 cm) wide with the interior approximately 3 inches (7.6 cm) wide and 3 inches (7.6 cm) deep. The outlet pipes inside the gutter should be at least 2 ½ inches (6.4 cm) in diameter and the cover grate should be 1 ½ times the size of the outlet pipe.

(2) Skimmers should be provided at the ratio of one skimmer for each 500 square feet (47 square meters) of pool surface, or fraction thereof. They should be located to ensure proper skimming of the pool surface. The rate of flow through the skimming device(s) must be adjustable up to a minimum of 80 percent of the capacity of the swimming pool filter system. Each skimmer should have a flow of at least 30 gallons per minute (114 liters per minute). The skimmer intakes should be designed to adjust automatically with variations in the water level over a range of at least 3 to 4 inches (7.6 to 10 cm). Skimmers are provided with a removable screen or basket which the recirculating water must pass through and a device to prevent airlock in the suction line, normally a surge tank or an equalizer pipe.

(3) The main drain should be capable of completely draining the pool in 4 hours. Pools with deep ends should have one or two outlet drains located at the deepest point. The location of drains depends on the size of the pool. Generally, drains should not be located more than 20 feet (6 m) apart nor more than 10 feet (3 m) from a sidewall. Either the main drain should be clearly marked by laying colored tile around the drain perimeter or the grating should be painted a conspicuous color. A grating shall cover the main drain outlets at least four times the size of the discharge pipe. The openings in the grating should be no larger than ½ inch (1.3 cm) to avoid catching hands and feet. The maximum discharge of water through any drain outlet should not exceed 1 ½ feet per second (50 cm per second). It is important the main drains not be located near the diving trajectory area to preclude the possibility of divers landing on the grate if they touch bottom. The main drain(s) should be designed with a capacity to recirculate at least 50 percent of the recirculating water, thereby improving circulation in all areas of the pool. The drain must not have a direct connection to the sewer, but must be provided with an air gap to prevent the possibility of backflow.

b. **Surge Tank.** This tank is located on the suction side of the recirculating pump and serves as a means of maintaining a constant level of water whenever pool water is lost through evaporation and splash. It can also be used as a site to introduce chemicals in an emergency. The fresh water inlet must be protected from backsiphonage by an air gap or backflow prevention device.

c. **Chlorinator-Hypochlorinator.** These devices are designed to introduce chlorine into a swimming pool recirculating system. A chlorinator injects chlorine gas and a hypochlorinator introduces a liquid containing chlorine. It is recommended that chlorine be introduced into recirculation on the suction side of a vacuum type diatomaceous earth filter or the newer high-rate sand filters. Automatic chlorinators maintain the chlorine residual at a predetermined level by controlling a solenoid valve on the chlorine injector adjusting the chlorine gas flow, as required. Automatic chlorinators are recommended as standard equipment for Navy and Marine Corps training and swimming pools. Gas chlorinators should have as a standard accessory a siphon breaker (vacuum breaker) installed between the injector and the point of application, when the chlorinator and the auxiliary equipment are located higher than the surface of the pool water. This breaker is necessary in the event of recirculating pump failure or shutdown since the water in the recirculation system tends to drain into the pool causing a negative head. If the recirculating pump automatically activates the chlorinator, it may continue to operate and fill the empty recirculation system with chlorine gas. When the recirculating pump is restarted, the undissolved chlorine gas could be discharged into the pool and result in injury to swimmers.

d. **Chemical Feeders**

(1) An adjustable chemical feeder to inject soda ash should be provided prior to the filters on the suction side of the recirculation system.

(2) Pools using conventional rapid-flow pressure sand filters (designed to operate with a flocculant) are equipped with an alum solution feeder located on the suction side of the recirculation pump.

(3) If diatomaceous earth filters are used, they will have slurry feed equipment to continuously apply diatomaceous earth to the recirculating water during a filter run.

e. **Vacuum Cleaners**

(1) The standard vacuum cleaner is permanently installed with suction hose fittings built into the wall of the pool and the piping connected to the suction side of the recirculation pumps. The connections for the vacuum cleaning hose are submerged and located so the entire surface of the pool may be reached. The cleaning water is recirculated.

(2) Occasionally, non-standard vacuum units may be found in older pool installations. These consist of a pump mounted on wheels that is pushed around the pool edge. The base and vacuum head are attached to the pump with the discharge side usually attached to a waste drain, resulting in a considerable water loss each time the pool is cleaned. Another type is a self-propelled vacuum cleaner, which rolls unattended along the bottom of a pool. This vacuum unit pumps water and dirt through a fabric bag, which retains the debris with no water loss. This vacuum type may be used as an auxiliary unit. The standard vacuum system should always be provided with new construction, modifications, or renovation.

f. **Interceptors (Hair Strainers).** Strainers are located on the suction side of the recirculation pumps and prior to a vacuum-type diatomaceous earth filter. Strainers should be made of corrosion resistant metal with openings not more than one eighth inch (0.3 cm) in diameter. The straining surface should be at least 10 times the size of the inlet area. Pools intended for training must be provided with two interceptors.

g. **Recirculating Pumps.** Pumps will be capable of passing a minimum of three (preferably four) times the pool volume through recirculation in 24 hours. In addition, they must have sufficient capacity and pressure to backwash the filters. Training pools should have two pumps.

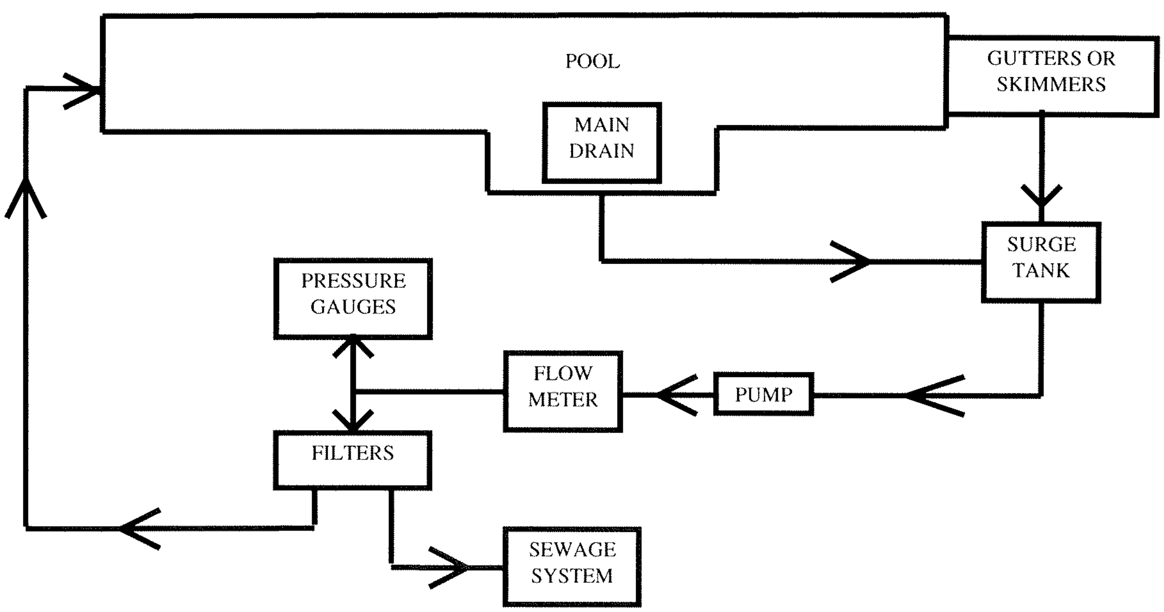
h. **Filters**

(1) **Sand Filters.** Conventional rapid-flow pressure filters and high-rate sand filters are used for Navy and Marine Corps pool installation (see Figure 4-1).

(a) Conventional, rapid-flow pressure filters consisting of sand or anthracite filter media are common. The filters are designed to operate with a flocculant (aluminum sulfate) that is injected into the recirculating water on the suction side of the filters. By design, the operating flow rate should not exceed 3 gallons per minute (11 liters per minute) for each square foot of filter surface. The surface area must be sufficient to recirculate the total volume of the pool three or four times each day. A bank of two to five filter tanks is normally required for standard sized pools. The tanks contain a media that consists of four layers of coal or sand and gravel. The layers are coarse at the bottom and very fine at the top. There should be 6 to 10 inches (15 to 25 cm) of space between the surface of the filter and the baffle on the inlet pipe to prevent the full stream of water from directly striking the sand. Each filter tank must have an air relief valve at the highest point and at least one access manhole for inspecting, removing, or replacing the media. Recirculating water flows from top to bottom and can be reversed by opening and closing valves. Backwashing (cleaning) requires a reverse flow of 12 to 15 gallons per minute (45 to 57 liters per minute) for each square foot of filter area for sand and 8 gallons per minute (30 liters per minute) for anthracite. Backwashing should commence with 6 to 8 pounds loss of head and continue until the effluent runs clear, usually about 15 minutes. Water from backwashing is discharged to waste.

(b) High-rate sand filters operate on a different principle, approximately the top 10 inches (25 cm) of sand collects suspended matter. No flocculant is used with high-rate sand filters. The operating flow rate is approximately 20 gallons per minute (76 liters per minute) per square foot of filter area. Usually one filter tank provides sufficient filter surface for one pool. The filter medium is either coal or sand of fine uniform size. An air relief valve is located at the top of tank. Backwashing is indicated by a 15 to 20 pound loss of head. The backwash flow rate is 15 to 20 gallons per minute (57 to 75 liters per minute) per square foot of surface area. Backwash time is rapid; only 2 to 4 minutes are required.

Figure 4-1. Sand Filter Diagram



(2) **Diatomaceous Earth Filters.** Water is filtered by passing it through a thin coating of diatomaceous earth that is impinged on a filter septum (or leaf). These filter septa have very small (about 0.005 inch) openings. The water is forced through the filter by either positive or negative pressure (vacuum). The flow rate is 2 gallons per minute (7.6 liters per minute) per square foot of filter element. Space requirements are about the same as high rate sand filters. Diatomaceous earth filters require more attention than sand filters. Backwashing, depending on the manufacturer, is accomplished by reversing the flow, by air pressure or by hand rinsing with a hose. When backwashed, the used diatomaceous earth must be disposed of in a manner satisfactory to local regulatory agencies.

i. **Gauge**

(1) A pressure gauge is installed on the inlet and outlet lines of each pressure filter to determine loss of head and backwash intervals.

(2) A gauge to indicate rate of flow must be installed in the return piping after the filtration system. It should be capable of measuring 1 ½ times the design flow rate and must be accurate within 10 percent of the true flow rate.

j. **Temperature**

(1) **Heating System.** Heating units are usually located in the recirculation system. Heaters must not be installed in the pool. The introduction of live steam into the pool is prohibited.

(2) **Water Temperature.** The water temperature in swimming pools should be maintained between 65°F to 82°F (18.3°C to 27.8°C).

(a) **Water Temperature of Indoor Pools.** A compromise in water temperature may be necessary between competitive and recreational needs for multi-use pools.

1. Pools used exclusively for competition should be maintained between 76°F to 78°F (24.4°C to 25.6°C).

(3) **Air Temperature.** In winter, the air temperature in indoor pool facilities should be kept approximately 3°F higher than the pool water temperature, while in summer, 8°F above is satisfactory.

k. **Pool Water Inlets.** Inlets from the filters must be located to produce uniform circulation of water through the entire pool. To reduce the escape of chlorine, the inlets shall be submerged a minimum of 1 foot (30.5 cm) below the pool water line.

4-10. EQUIPMENT AND DISINFECTANT STANDARDS

a. Swimming pool equipment for new construction of pools at Navy and Marine Corps facilities should bear the seal of the National Sanitation Foundation (Standard #50) or be equivalent. The following equipment is listed in Standard #50:

(1) Diatomaceous earth type filters.

(2) Sand type filters.

(3) Recessed automatic surface skimmers.

(4) Centrifugal pumps.

(5) Adjustable output rate chemical feeding equipment.

(6) Multi-port valves.

(7) Cartridge and high permeability type filters.

(8) Flow through chemical feeding equipment.

b. Disinfection

(1) Chemical disinfection is an integral part of pool water treatment.

(2) Chlorine is the only disinfectant approved for use in training and bathing facilities. The strong disinfecting and oxidizing properties of chlorine aid in making water bacteriologically safe, free from algae and organic matter, and aesthetically acceptable to the bather.

(3) The use of other disinfectants (e.g., iodine and bromine) is discouraged without prior written approval from NAVFACENGCOM and BUMED.

(4) Chlorination. Chlorine can be introduced in the pool water as a gas (99.9 percent available chlorine), as calcium hypochlorite (65 to 75 percent available chlorine), and as sodium hypochlorite.

(5) Chlorine Gas. Chlorine in the gaseous state is extremely toxic and heavier than air. Strict adherence to safety regulations is required. Chlorine gas rapidly lowers the pH of the pool water. Soda ash is necessary to maintain a properly balanced pH.

(6) Calcium Hypochlorite is 65 to 75 percent available chlorine bonded to granulated calcium. The chlorine in calcium hypochlorite is released from the granulated calcium bond by dissolving it in water. The liquid supernate is then transferred to a hypochlorinator, which automatically adds the chlorine solution to the pool water. There will be a slight rise in pH.

(7) Sodium Hypochlorite is a slightly yellowish liquid in concentration of 12-15 percent available chlorine. The liquid can be added to the pool by a hypochlorinator. The pH will rise slightly with use of the liquid.

4-11. WATER TREATMENT

a. **Clarity.** Pool water must be free of suspended matter and sufficiently clear so you can see, from the pool sides, a 4-inch (10.2 cm) diameter black on white disk at the floor level of the deepest end of the pool. The main drain(s) should be visible at all times.

b. **Chemical Balance.** Chemical treatment alone will not produce sanitary pool water. A filtration system in proper operational condition is also required to attain sparkling clear, polished, sanitary water.

(1) **Chlorine Disinfection, Background**

(a) When gas chlorine is introduced into pool water, the resulting chemical reaction forms two compounds of interest: hydrochloric acid (HCl) and hypochlorous acid (HOCl). In chlorination, HCI is not considered a useful compound. This compound lowers the pH of water. When sodium or calcium hypochlorites are used as the source of chlorine, the resulting sodium and calcium hydroxides serve no useful purpose and raise the pH of the water. Soda ash is introduced to neutralize the lowering of the pH by gas chlorination. Sodium bisulfate is introduced to neutralize the rise in pH by sodium and calcium hypochlorites. HOCl, formed from all sources of chlorine, is an effective oxidizing agent and bactericide and is referred to as "free available chlorine (FAC)."

(b) FAC. This compound exists in the molecular (HOCL) or ionized state (OCL-). The pH of the pool determines the amount in each state. HOCL is approximately 300 times more effective as a bactericide than in the ionized state. Table 4-4 indicates the effect of pH on FAC or HOCL at 68°F (20°C). ***FAC should be maintained at a minimum of 1.0 ppm.*** A maximum level of 3.0 ppm FAC may be required for hot weather/heavy use.

(c) FAC is an excellent oxidizing agent that will oxidize organic matter and many inorganic compounds. If the amount of FAC in the pool is insufficient to oxidize all the nitrogen (ammonia) compounds present, then chloramines will be formed. Nitrogen (ammonia) compounds from bathers (e.g., perspiration) are always available in the pool to form chloramines. The formation of chloramines is referred to as combined chlorine residual. Combined chlorine (chloramines) is not as effective in disinfection as FAC. Chloramines produce eye irritation and the objectionable "chlorine" odor associated with pools.

Table 4-4. Effect of pH on Hypochlorous Acid in Pool Water at 68°F (20°C)

pH of Pool Water	Hypochlorous Acid in Molecular Form (HOCL)
6.0	96.8%
7.0	75.2%
8.0	23.2%
9.0	2.9%

(d) Breakpoint Chlorination. When FAC is added to water containing ammonia compounds, it reacts with the ammonia to form chloramines. When the total chlorine residual (free available plus combined chlorine residual) increases to a concentration that forces the ammonia compounds to be burned off (oxidized), a sudden drop in the chlorine residual, called breakpoint chlorination, occurs. At breakpoint, most of the combined residual disappears along with eye irritation and the objectionable "chlorine" odor. The remaining chlorine in the water is mainly in the free available state. Breakpoint chlorination will occur at different concentrations in different waters.

(e) Cyanurates (Stabilized Chlorine). Cyanuric acid is used in outdoor pools to "stabilize" the chlorine from rapid destruction by ultraviolet light from the sun. Cyanuric acid can be added to any pool water using chlorine (gas or hypochlorites). Chlorinated cyanurates are commercially available as a single chemical containing a combination chlorine and cyanuric acid. Regardless of the source or concentration, the effect of cyanuric acid in pool water is the same. Cyanuric acid has no chlorine demand and does not affect the breakpoint chlorination phenomenon. Cyanuric acid has little or no affect on the bactericidal properties of chlorine at the concentrations and pH recommended for pool water. Cyanuric acid residuals can be reduced by dilution with cyanuric acid-free water. Cyanuric acid concentrations in excess of 100 ppm are not recommended. Handle and store the chemical as recommended by the manufacturer.

(2) **Aluminum Sulfate (Alum)**

(a) Conventional rapid flow pressure filtration systems are designed to use the process of flocculation to enhance the filtering efficiency.

(b) Alum is injected into the recirculation system causing suspended particles to clump together. The flocculated matter produces a thin, jelly-like mass on the top layer of filtering medium.

(c) The alum is introduced into the water by a chemical feeder located on the suction side of the recirculation pumps.

(d) The alum solution should be made with granulated plain aluminum sulfate.

(e)When alum is used, the alkalinity level should be maintained at 80-120 ppm to permit the alum to function properly and to prevent drastic fluctuations in pH and alkalinity.

(3) **pH**

(a) **General.** pH is the logarithm of the reciprocal of the hydrogen ion concentration of water. Pure (distilled) water (H_20 or HOH) is a compound which will ionize to form an equal amount of hydrogen ions (H+) and hydroxyl ions (OH-). An acid is a compound which ionizes to produce an excess of hydrogen ions. A base is a compound which ionizes to produce an excess of hydroxyl ions. pH has a value range of 0-14; 0 is very acidic, 7 is neutral, and 14 is very alkaline. The pH of a solution does not indicate how much acid or base is present, but indicates the degree of ionization. This point is very important when alkalinity is discussed.

(b) **Range.** The pH range for pools must be maintained between 7.2 to 8.0. Accurate pH control is essential. Corrosion to pipes, filters, and pumps will result in a short time when the pH is below 7.0. High pH values will reduce the effectiveness of the disinfectant and encourage the growth of algae. Eye irritation will occur if the pH value is below 7.2 or above 8.0.

(c) **Control.** The addition of soda ash (alkaline compound) will raise the pH of water. The addition of sodium bisulfate (acid compound) lowers the pH of water. Correction of other chemical imbalances (alkalinity and hardness) will often return the pH to normal.

(d) **Comfort.** Water is less irritating to the bather at a pH of 7.6 to 8.0; however, chlorine is more effective as a bactericide at 7.2 to 7.6.

(4) **Alkalinity**

(a) **General.** Alkalinity is a measure of the ability of a solution to neutralize hydrogen ions (H+) or act as a buffer. Alkalinity exists in pools in three forms: Bicarbonate (HCO_{3-}), carbonate (CO_3^{-2}), and hydroxide (OH-). The form is dependent on the pH of the water. Hydroxide alkalinity is irritating to the eyes and cannot occur if the pH is much below 9.0. Carbonate alkalinity is also irritating to the eyes and exists in a pH range of approximately 5.0 to 9.0. If a pool has a proper pH balance, the predominant form of alkalinity present would be in the bicarbonate form.

(b) **Range.** Alkalinity assists in maintaining stable pool pH. The values should be between 80-100 ppm for proper alkalinity of the pool. If the alkalinity is less than 60 ppm, the pH can change rapidly due to bather load, temperature, addition of chlorine, or pH adjustment. When the alkalinity is too high, usually greater than 180 ppm, the pH adjustment is difficult.

(c) **Adjustment of alkalinity.** Sodium bicarbonate can be used to raise the alkalinity level with little effect on pH. The resulting alkalinity (80-100 ppm) serves as a buffer to ensure a stable pool pH.

(d) **Effect on Filters.** Proper alkalinity balance is necessary in pools using alum floc on conventional sand filters, because the alum must react with alkalinity to produce the floc. If the alkalinity is too low, the alum will pass through the filters in the dissolved form creating a floc in the pool when the alkalinity is adjusted.

(5) **Hardness**

(a) **General.** Hardness is a measure of the mineral content of water. Calcium, magnesium, and iron are the major mineral compounds that cause problems in pools. These compounds interfere with pool clarity and bather comfort.

1. Calcium and magnesium compounds cause encrustation of pipes, especially water heaters and fittings. Filter encrustation will occur largely from calcium compounds.

2. Iron compounds will impart a green color to the pool water. A reddish-brown precipitate will also occur which can discolor pool walls and floors, and clog filters.

(b) **Treatment**

1. Calcium and Magnesium. Encrustation of pipes, heaters, and fittings from calcium or magnesium can be removed by treatment with an acid (e.g., muriatic acid). Only enough must be used to react with the minerals to prevent damage to the pipes and equipment. The use of soda ash will continually precipitate out the calcium compounds.

2. Treatment of iron-bearing water with high chlorine residuals will oxidize the iron compounds. The resulting precipitate (a red-brown ferric oxide) can then be filtered out. Usually, the appearance of iron compounds in the pool is a result of the pH dropping to 7.0 or below in pools with iron pipes and equipment.

(6) **Algae Control.** A major concern in swimming pool maintenance is the prevention of algae growth. Although algae are harmless from a communicable disease standpoint, they contribute to making walls, pool floors, and walkways slippery and creating safety hazards. Pool conditions which promote algae blooms may also permit the survival of harmful bacteria. Chlorine, if present under these conditions, will probably be in the combined form (chloramine), which will cause eye irritation.

(a) The best control measure for algae is to prevent its growth. This, in almost all cases, can be accomplished with proper FAC residual.

(b) Swimming pools, especially outdoor pools, should be superchlorinated to 5-10 ppm FAC weekly to control algae growth.

(c) If algae blooms become established in a pool, the removal becomes more difficult. Superchlorination followed by pool brushing and vacuuming may suffice. If large blooms have become established, it will probably be necessary to drain the pool and scrub all surfaces with a 200 ppm FAC solution. Adding one ounce (30 milliliters) of household bleach to 2 gallons (7.6 liters) of water can make this solution.

(d) The use of commercial algicides or algistatics is not generally recommended because, frequently, the active ingredient is simply chlorine. Algicides containing mercury, once widely used, are prohibited in the United States. In those rare instances when algae have demonstrated a resistance to chlorine, algicides with copper sulfate may be used. The pool should be drained of water and the sides scrubbed with a solution containing 5 percent copper sulfate by weight. The solution may then be flushed to waste.

4-12. SAFETY AND SWIMMING POOL REGULATIONS. Death and injury related to swimming pool accidents increase each year. The key ingredients to preventing such accidents are proper pool design, maintenance, supervision, and a "clear cut" set of safety regulations. The following guidelines must be practiced at each facility.

a. **Safety Lines.** The diving well or deep end will be divided from the rest of the pool by use of an appropriate buoy line tightly fastened at each side of the pool. The safety line should be located 1 to 2 feet (30-60 cm) from the breakpoint over the shallow portion of the pool.

b. **Diving Boards.** All diving boards, above 3 feet 4 inches (1 m), must have steps and hand rails. Except during diving competition or exhibitions, the fulcrum should be permanently locked and/or relocated to the forward most position, which reduces overall board spring.

c. **Lifeguard Stations**

(1) One guard is required for up to 50 bathers and an additional guard for each designated diving area. If a pool has two separate diving areas, an additional guard will be required in each separate diving area.

(2) The placement of lifeguard stations, whether in elevated chairs or not, shall be so that the lifeguard is not distracted by patrons, has no sight obstructions or glare, is able to see (scan) all patrons every 10 seconds and is able to respond quickly to any distressed patron.

(3) In small pools (less than 2,000 square feet of water surface area), one guard may be adequate to safely guard the diving and swimming areas if the combined zones represent one overall pool facility.

(4) In large pools (over 10,000 square feet of water surface area) the job of supervision becomes more difficult. Generally, this size pool contains areas in the middle that are extremely difficult to see and adequately supervise from the sides. Therefore, more guards may be appropriate and/or movable guard stands as necessary.

(5) The maximum number of bathers in the swimming pool at any one time will not exceed one bather for each 50 square feet of water surface of the pool. The maximum of one occupant per 30 square foot of pool deck will not be exceeded without permission of the local fire department.

(6) Based on conditions, i.e., holidays, patron load, weather, etc., additional guards may be required.

d. **Life-Saving Equipment.** Sufficient emergency life-saving equipment must be provided at each lifeguard station. Rescue equipment will be maintained in ready to use condition. The minimum equipment should include a rescue tube or cam, along with a high reaching pole or a shepard's crook, a ring buoy with a throwing line attached, and a whistle and bull horn.

e. **First Aid Equipment.** Each pool will have the following minimum first aid equipment:

(1) Stretchers.

(2) Blankets.

(3) First aid kit approved by the local medical treatment facility. The kit will include bloodborne pathogen protective equipment, e.g., masks, shields, latex gloves.

(4) Drinking water.

(5) First aid cot.

(6) Pillow.

(7) Telephone with emergency numbers.

(8) Splints.

(9) Back board.

f. **Personnel Training**

(1) Pool operators and lifeguards will be trained and certified in basic rescue and life-saving techniques (i.e., certification by the American Red Cross or Young Men's/Women's Christian Association).

(2) In addition, personnel will receive bloodborne pathogen training and be enrolled in the local bloodborne pathogen program as appropriate.

(3) Hazard communication training and appropriate storage practices for pool chemicals will be provided in accordance with 29 CFR part 1910.1200 and OPNAVINST 5100.23E, Navy Occupational Safety and Health Manual.

g. **Pool Regulations.** A placard including, but not limited to, the following rules and regulations pertaining to swimmer sanitation and safety must be posted in a prominent location.

(1) All patrons must comply with the directions and signals of lifeguards and/or the pool manager.

(2) Personnel must take a cleansing shower prior to entering the pool.

(3) No persons with sores, skin diseases, or bandages will be permitted in the pool.

(4) Spitting, urinating, or otherwise contaminating the pool or walkways is prohibited.

(5) Eating, drinking, or smoking in the pool or on the pool deck is prohibited.

(6) No pets are allowed in pool area. (A guide dog escorting a blind person will be permitted on the pool deck and in restrooms. Also, working dogs accompanied by handlers will be permitted in swimming pool areas as required.)

(7) Boisterous or rough play is not permitted in the pool area.

(8) Rafts, air mattresses, or flotation devices that could easily become detached from the user are prohibited (life jackets, water wings, or similar personal safety items may be used by non-swimmers and are permitted in the shallow area only).

(9) Non-swimmers are permitted in shallow area only.

(10) Diving is permitted in designated areas only.

(11) Gymnastics will not be permitted on the diving boards.

(12) Swimming is not permitted in diving areas. Double bouncing is not permitted; only one bounce per dive.

(13) No fraternizing with lifeguards.

(14) Climbing on lifeguard towers or using lifesaving equipment for other than emergency use is strictly prohibited.

4-13. SANITATION INSPECTIONS

a. Navy and Marine Corps swimming pool facilities shall be inspected at least monthly by a Preventive Medicine Authority in company with the pool manager or designated representative. Special inspections should be performed prior to opening the pool each season, prior to opening a new pool, and prior to opening a pool after renovation. An inspection must be conducted when disease transmission is suspected or upon request of the recreation director or the public works officer.

b. Inspections of pools include chlorine residual and pH testing and a review of bacteriological analysis results. Pool personnel should be trained to perform field tests for chlorine residual (combined and FAC), pH, alkalinity, hardness, clarity, air and water temperature, and cyanurates (if applicable). A D.P.D. chlorine test kit must be kept on hand for testing of FAC and pH following directions accompanying the kit.

4-14. BACTERIOLOGICAL ANALYSIS

a. All sample containers must contain a 10 percent sodium thiosulfate solution to neutralize chlorine, and be sterile. Collect samples in the area of, and during the time of, maximum bather use. Refrigerate the sample at 50°F (10°C) and test within 6 hours of collection.

Identifying data, such as sampling time, location of sampling site, and desired analysis, should accompany the sample.

b. Standards. Microbiological testing of swimming pool water is used to evaluate the disinfection process and to obtain a measure of the potential for pathogen transmission. Samples should be analyzed following the latest edition of *Standard Methods for the Examination of Water and Wastewater*. A satisfactory sample will demonstrate the absence of total coliform bacteria. If a sample is total coliform-positive, three daily repeat samples will be taken as soon as possible. If two of the three repeat samples are total coliform-negative, the pool water is considered bacteriologically satisfactory. For more information concerning microbiological testing using "presence" or "absence" results, refer to Chapter 5 of this manual (NAVMED P-5010-5, Water Supply Ashore).

4-15. RECORDS. Records are necessary for evaluation of pool operation, investigation of complaints, and to justify mechanical improvements. They should be examined as part of the pool sanitation inspection. The following records should be kept by the pool manager:

a. Total number of swimmers each day and the peak number of swimmers using the pool each day.

b. Lengths of time the pumps and filters are in operation each day.

c. Time and date each filter is backwashed and cleaned.

d. Amount of chemicals added and time of their addition (e.g., alum, soda ash).

e. Hourly record of chlorinator and chemical solution feeder settings.

f. Inventory of chemicals on hand.

g. Dates of vacuum cleaning.

h. The pH test results, three times daily or as frequently as necessary to assure the pool is within prescribed limits.

i. The total alkalinity and/or calcium hardness each time accomplished.

j. Residual chlorine readings (at least one test during each 2 hours of use at varying locations in the pool with one test to be made at the time of the maximum swimming load).

k. Temperature reading as often as necessary to indicate adequate temperature control.

l. Results of bacteriological laboratory analysis of swimming pool water accomplished monthly or more often as required.

Section III. PUBLIC SPAS AND HOT TUBS

4-16. DEFINITION. Spas and hot tubs are also known as whirlpools, jacuzzis, hydrotherapy pools or soaking tubs, but will be referred to in this text as "hot tubs." Hot tubs are designed for one or more people to soak in, not bathe. Many brands and types are available for recreational use and require careful operation and maintenance.

4-17. CONSTRUCTION. Hot tubs must be constructed and installed in accordance with: *Suggested Health and Safety Guidelines for Public Spas and Hot Tubs,* HHS-99-960, latest edition; local regulations; and manufacturer's instructions.

4-18. RETURN INLETS AND SUCTION OUTLETS

a. **Location.** Return inlet(s) and suction outlet(s) shall be provided and arranged to produce circulation throughout the spa.

b. **Testing and Certification.** Spa suction outlets shall be provided with a cover tested and accepted by a nationally recognized testing laboratory and comply with ANSI/ASME A112.19.8M 1996, Suction Fittings for Use in Swimming Pools, Wading Pools, Spas, Hot Tubs, and Whirlpool Bathtub Appliances.

c. **Important Safety Note.** Do not use or operate spa if the suction outlet fitting is missing, broken, or loose.

d. **Entrapment Avoidance.** If the suction outlet system, such as an automatic cleaning system, is a vacuum cleaner system which has a single suction outlet or multiple suction outlets which can be isolated by valves, then each suction outlet shall protect against user entrapment by either an antivortex cover or other means.

e. **Outlets Per Pump.** A minimum of two suction outlets shall be provided for each pump in the suction outlet system, separated by a minimum of 3 feet or located on two different planes, i.e., one on the bottom and one on the vertical wall, or one each on two separate vertical walls. These suction outlets shall be plumbed such that water is drawn through them simultaneously through a common line to the pump.

f. **Cleaner Fittings.** Where provided, the vacuum or pressure cleaner fittings shall be located in an accessible position(s) at least 6 inches and not greater than 18 inches below the mini-mum operating water level or as an attachment to the skimmers.

4-19. WATER SUPPLY. The water for use in hot tubs will be obtained from potable water sources. To avoid cross-connection, the water supply line must have an air gap or backflow preventer. Overflow water should be returned to the filter system or discharged to an approved waste water system. Where overflow is discharged to sewer, an air gap must be provided above possible flood and sewer backup levels.

4-20. SANITARY FACILITIES. Sanitary facilities will be provided for use by hot tub patrons. A thorough shower must be taken prior to entering the hot tub.

4-21. FILTRATION. The two most commonly used filters in hot tubs are the diatomaceous earth filter and rapid rate sand filter. For filter operation and other filter applications see article 4-9h. The circulation equipment must be capable of complete water turnover in 30 minutes. The proper water level must be maintained at all times by filling or draining the hot tub according to the manufacturer's instruction.

4-22. WATER QUALITY. Hot tubs usually have a higher number of users per water volume than a swimming pool. Additionally, the high temperature and constant motion of the water make it difficult to maintain the proper chemical levels.

a. **Temperature.** The maximum temperature at Navy and Marine Corps hot tub facilities is 104°F (40°C). A temperature at 100°F (38°C) is considered safe and comfortable for a healthy adult. At higher water temperatures, the soaking time should be shorter. Limit exposure to 20 minutes at 102°F (39°C) and to 10 minutes at 104°F (40°C). Temperature adjustment should be limited to hot tub operators only.

b. **Disinfection.** Chlorine is the most frequently used disinfectant in Navy hot tubs. However, bromine disinfectant systems registered with the Environmental Protection Agency are acceptable alternatives. Other bactericidal agents may be used only with BUMED approval. At least weekly, the hot tub water must be superchlorinated to 10 ppm for 10 hours. The chlorine level must drop to 3 ppm before use. The following guidelines for hot tub water quality shall be observed:

Table 4-5. Water Chemistry Parameters for Hot Tubs

Check Hourly During Use	Range	Optimum
Free Residual Chlorine	1-3 ppm	1.5 ppm
Total Bromine Residual	0.8-3 ppm	1.5 ppm
pH	7.2-7.8	7.5
Check Weekly	**Range**	**Optimum**
Total Alkalinity	60-200 ppm	100 ppm

4-23. HOT TUB INSPECTION. Hot tubs will be inspected monthly and tested for chemical and bacteriological water quality as stated in article 4-13.

a. **Bacteriological Testing.** Bacteriological testing will be conducted monthly.

b. **Management Records.** Hot tub management records will be examined as stated in article 4-15.

c. **Turbidity.** Water should be clear and not appear cloudy or colored. If water clouds or colors, increase filtration. If unsuccessful, backwash filters and check chlorine and pH levels. If necessary, drain and clean hot tub to restore water clarity.

4-24. CLEANING. Hot tub water must be drained at least monthly. The sides, bottom, decks, and railings should be scrubbed with a 50 ppm chlorine solution. Upon refilling, superchlorinate to 10 ppm, allow level to drop to 3 ppm, and check pH before use. In addition to regular cleaning, a thorough draining and cleaning will be necessary if patrons report any skin rash while using the hot tubs. Decks and rails must be kept clean and algae free by brushing with a 50 ppm chlorine solution as needed.

4-25. GENERAL SAFETY

a. **Obstructions.** There shall be no obstructions that can cause user to be entrapped or injured. Types of entrapment can include but not be limited to such things as wedge or pinch-type openings and rigid, non-giving cantilevered protrusions.

b. **Signs.** Signs which state safety, emergency, and operational aspects of the spa shall be prominently located in the immediate vicinity of the spa, stating the spa's address, the location of the nearest telephone with references that emergency telephone numbers are posted at the location. Those emergency telephone numbers should include the name and telephone number of the nearest available police station, fire ambulance service, and/or rescue unit, and/or "911" services, if available.

(1) **Safety Signs.** Safety signs shall include but not be limited to the following messages:

(a) **Risk of Fetal Damage.** Hot water exposure limitations vary from person to person. Pregnant women and small children should not use spa prior to medical consultation.

(b) **Medical Considerations/ Precautions.** Persons suffering from heart disease, diabetes, high or low blood pressure, and other health problems should not enter the spa without prior medical consultation and permission from their doctor.

(c) **Risk of Drowning.** Do not use the spa while under the influence of alcohol, narcotics, or other drugs that cause sleepiness, drowsiness, or raise/lower blood pressure. Use caution when bathing alone. Overexposure to hot water may cause nausea, dizziness, and fainting. Lower water temperatures are recommended for extended use (exceeding 10-15 minutes) and for young children. Do not allow the use of or operate spa if the suction fitting is missing, broken, or loose.

(d) **Risk of Child Drowning.** Unsupervised use by children is prohibited.

(e) **Risk of Injury.** Check spa temperature before each use. The spa temperature should not exceed 104°F. Enter and exit slowly. Keep all breakable objects out of the spa area.

(f) **Risk of Shock.** Never place electrical appliances (telephone, radio, TV, etc.) within 5 feet of the spa. The spa shall not be operated during severe weather conditions, i.e., electrical storms, tornadoes, etc. The location of the master cut-off switch must be identified.

(g) **Secure the Facility.** Secure against unauthorized access.

(2) **Operational Signs.** Operational signs shall include but not be limited to the following messages:

(a) Do not allow the use of or operate spa if the suction fitting is missing, broken, or loose.

(b) Check spa temperature before each use. Do not enter the spa if the temperature is above 104°F.

(c) Secure the facility against unauthorized access.

(d) Keep all breakable objects out of the spa area.

(e) Spa shall not be operated during severe weather conditions, i.e., electrical storms, tornadoes, etc.

(f) Never place electrical appliances (telephone, radio, TV, etc.) within 5 feet of the spa.

Section IV. NATURAL BATHING PLACES

4-26. BEACHES, FRESH AND SALTWATER

a. This section applies to any body of water not contained within a structure, but which is under control of the Navy or Marine Corps for swimming, diving, or recreational bathing. This includes seashore, natural lakes, reservoirs and impoundments, ponds, rivers, streams, and associated buildings or equipment.

b. Planning and Review Considerations

(1) A sanitary survey will be conducted by the medical department representative or preventive medicine authority of proposed bathing sites to establish the presence or absence of contamination and its source. Consultative survey support should be obtained from a Navy/ Marine Corps civil engineer. The survey should include a bacteriological study plus an inspection for such safety hazards as currents, changes in depth, underwater obstructions, visibility, marine life, and temperature. Potential sources of contamination should be identified (e.g., sewer and industrial wastewater outfalls, stormwater outfalls, and contaminated surface water runoff). Consideration should be given to the possibility of the presence of endemic infectious agents transmitted indirectly through water. Provisions for a potable water supply, wastewater disposal, and solid waste disposal must be an integral part of the survey.

(2) Bather load should be anticipated to determine the type and amount of sanitary facilities necessary. The bathhouse should be constructed and maintained following article 4-8k. Toilet facilities should be located within 500 feet of the beach and provided with plumbing fixtures as recommended in Table 4-6 below:

Table 4-6. Natural Bathing Places: Sanitary Facilities Required Based Upon User Load

Facility	Male	Female
Water Closet	1/200	1/150
Lavatories	1/200	1/200
Urinals	1/300	0
Showers	1/100	1/100
Drinking Fountains	1/100	1/100

(3) Playground equipment, if provided, will be in accordance with Chapter 2 of this manual, (NAVMED P-5010-2, Sanitation of Living Spaces and Related Service Facilities).

(4) An adequate number of solid waste receptacles with covers will be placed in the beach area and should be emptied at least twice weekly.

(5) **Prohibitions for Bathing Beaches.** Bathing beaches may be prohibited when contamination from sources outlined in article 4-26b(1) is likely as determined by the medical department representative, preventive medicine authority, or enforcing agency.

(6) **Design Criteria**

(a) **Area Designations**

1. Anchored buoys will be provided, where practical, to designate swimming perimeter and to separate deep and shallow water at approximately the 4-foot (1.2 m) depth. The diving area, dropoffs, underwater hazards, and wading areas, 2 feet (61 cm) and less, should be designated.

2. Warning marker buoys or floating signs indicating the "boats keep out" symbol (diamond shape and international orange) shall be used in beach areas where boating occurs in close proximity. A minimum of two warning buoys shall be spaced at a maximum of 200-foot intervals located to provide adequate warnings to vessels approaching the swimming area from various directions.

(b) **Diving Facilities.** Diving platforms, floating or fixed, must be constructed with 12 inches (30 centimeters) of visible airspace above the surface of the water and the bottom of the structure. Ladders will be provided for boarding the diving facilities. Swimming is not permitted under diving platforms or piers. Underwater construction will be kept to a minimum; however, it should be consistent with maximum swimmer support. All underwater construction will be designed to prevent entrapment of swimmers. No diving platform or diving device will be constructed at heights greater than 9 feet, 10 inches (3 meters) above the water surface. Table 4-7 specifies the minimum recommended depth of water in which diving platforms may be located.

Table 4-7. Water Depth Standards for Natural Bathing Place Diving Safety

Platform Type	Water Depth for a Distance of 12 Feet (3.7 m) in all Directions
Platforms 1.6 feet (0.5 m) above the water surface	9 feet (2.7 m)
Platforms 3.3 feet (1.0 m) above the water surface	10 feet (3.1 m)
Platforms 9.8 feet (3.0 m) above the water surface	12 feet (3.7 m)

(c) A potable water supply under pressure for drinking and sanitary purposes will be provided. If the source is not a public water system, it will be approved and monitored by the cognizant medical department representative or preventive medicine authority.

(d) **Sanitary and Bacteriological Survey.** A sanitary survey of an existing beach and surrounding area and a bacteriological survey of the water must be done prior to opening the beach at the beginning of the season and should be done periodically.

1. **Sanitary Survey.** The sanitary survey of existing beaches is similar to the survey of proposed bathing sites. Toilet facilities and bathhouses should also be inspected for sanitary condition.

2. **Bacteriological Survey.** The fecal coliform-fecal streptococcus ratio can be used as an indicator mechanism for evaluating the microbiological suitability of natural bodies of water. Ratios of 4.0 or higher typically indicate domestic sewage contamination while ratios of 0.6 or lower are common to discharges from farm animals or stormwater runoff. Refer to *Standard Methods for the Examination of Water and Wastewater* on the use of this ratio.

(e) **Safety Requirements**

1. At least one guard must be stationed for every 200 linear feet of designated beach front and should be posted at a tower at least 6 feet high. An additional guard will be available for duty that can serve as a backup within 2 minutes from the time a guard leaves the station for emergency action. A proven communication system, i.e., radio with separate frequency, telephone, whistle, etc., is essential. Lifeguard stations may be farther apart than 200 feet, but not to exceed 200 yards, where less crowded conditions prevail or heavy surf conditions preclude extensive bathing.

2. Sufficient emergency lifesaving equipment must be provided at each lifeguard station. Minimum equipment includes rescue tube or can, a long light reaching pole or shaper's crook, a ring buoy with a throwing line attached, whistle, and bull horn.

3. Each beach location will have signs posted at appropriate intervals listing beach regulations. Suggested regulations:

a. No swimming when lifeguard not on duty.

b. No swimming after dark.

c. No roughhousing or sand throwing.

d. No glass bottles or containers on beach.

e. No pets (A guide dog escorting a blind person will be permitted on the beach and in restrooms. Also, working dogs accompanied by handlers will be permitted on beach area as required).

f. Swimming in designated areas only.

g. No littering.

h. No scuba gear in swimming area.

i. No boards, canoes, or surfboards in swimming area.

j. No fishing in or near swimming area.

4. Normally beaches are operated by an aquatic supervisor, beach manager, or person responsible to the recreational director. The beach operator or another responsible person should make a check of the facility beach, water, and equipment prior to opening each day.

5. Records will be maintained which include, but are not limited to: name of the beach, names of persons on duty, general weather conditions, number of bathers, and water analysis reports.

4-27. OVER-THE-SIDE SWIMMING. OPNAVINST 3120.32C, chapter 5, article 510.60, authorizes commanding officers to permit over-the-side swimming. Depending on conditions, location, and class of ship, the "swim call" may be over-the-side, swimming in flooded well decks, or swimming from beaches. Medical Department personnel must be prepared to submit practical recommendations to commanding officers concerning health hazards and safety precautions for these evolutions.

a. Swimming over-the-side (in the immediate area of the ship) is prohibited when the ship is in water suspected or known to be contaminated. Unless approved by the senior officer present afloat, swimming over-the-side is prohibited in harbors or other fleet concentrations.

b. Any available medical intelligence concerning dangerous marine life, parasites, and waterborne diseases prevalent in the ship's geographical area should be considered prior to permitting swimming.

c. The water should be clear and free of floating or submerged debris, oil, algae, and dangerous marine life.

d. All suction and discharge outlets should be secured 30 minutes before swimming.

e. When the ship is anchored, a swimming area should be designated preferably with anchored buoys on the leeward side of the ship.

f. Adequate resting devices (e.g., lowered accommodation ladder, rope ladder, "Jacob's ladder," secured inflated rafts) must be provided to accommodate the swimmers.

g. Two swimmers, qualified as lifeguards, must be posted for each group of less than 100 swimmers, with one additional lifeguard for each additional 50 swimmers or fraction thereof.

h. One boat provided for "man overboard" must be in the water adjacent to the swimming area. An additional boat will be provided for parties larger than 100.

i. Two persons qualified in the use of small arms and provided with weapons and binoculars should be posted as shark guards in the ship's superstructure or other location with a clear view of the designated swimming area and adjacent waters.

j. A loudspeaker, megaphone, or the ship's 1 MC system should be available to the officer in charge of the swimming party to recall and direct swimmers. Additionally, he should have communication with the small boats, shark guards, and the bridge.

k. Swim call should begin not less than 1 hour after the last meal and be authorized only during daylight hours. The weather forecast should be for clear and calm weather. Personnel on the bridge should be alert for squalls or thunderstorms and should recall swimmers, as necessary.

4-28. FLOODED WELL DECK SWIMMING

a. Swimming in an enclosed well deck is preferred to over-the-side swimming, if practical.

b. Wash down bulkhead and deck with water and scrub soiled and greasy areas.

c. Two swimmers qualified as lifeguards will be posted for each group of less than 100 swimmers.

d. A complete exchange of water must be provided every 8 hours during periods of continuous use.

(6) U.S. Department of Health, Education and Welfare, *Swimming Pools, Safety and Disease Control Through Proper Design and Operation*, Publication No. (CDC) 77-8319, Centers for Disease Control, Public Health Service, Atlanta.

(7) U.S. Environmental Protection Agency, *Cross Connection Control Manual*, EPA Water Supply Division, Washington, D.C., 1989.

(8) National Fire Protection Association Life Safety Code, 1997 edition.

(9) National Spa and Pool Institute, *American National Standard for Public Swimming Pools*, Alexandria, VA, 1991.

(10) National Spa and Pool Institute, *American National Standard for Public Spas*, Alexandria, VA, 1992.

(11) Code of Federal Regulations Part 1910.1200, Hazard Communication.

(12) Code of Federal Regulations Part 1910.1030, Occupational Exposure to Bloodborne Pathogens.

(13) Environmental Engineering and Sanitation, 4th ed., J. Salvato, John Wiley & Sons, Inc., NY.

Section V. REFERENCES

4-29. REFERENCES. The following is a list of publications referenced and used in this chapter.

a. **Military Publications**

(1) Air Force Occupational Safety and Health (AFOSH) Standard 48-14, Swimming Pools, Spas and Hot Tubs, and Bathing Areas.

(2) Bureau of Naval Personnel, Aquatic Operator Handbook.

(3) MIL-HDBK-1190, Facility Planning and Design Guide.

(4) MIL-HDBK-1037/1, Training and Recreation Pools (publication pending).

(5) NAVMED P-5052-6A, Technical Information Manual for Medical Corps Officers, 1962.

(6) BUPERSINST 1710.11C, Aquatic Programs and Facilities.

(7) OPNAVINST 3120.32 series, Standard Organization and Regulations of the U.S. Navy.

(8) OPNAVINST 5100.23E, Navy Occupational Safety and Health (NAVOSH) Program Manual.

b. **Civilian Publications**

(1) American Public Health Association, *Control of Communicable Disease in Man*, 17th ed., Washington, D.C., 2000.

(2) American Public Health Association, American Water Works Association, and the Water Environment Federation, Standard Methods for the Examination of Water and Wastewater, 20th ed., Washington, D.C., 1999.

(3) New York State Department of Health, Chapter 1, State Sanitary Code, Subparts 6-1, 6-2, Swimming Pools, Bathing Beaches. New York State Department of Health.

(4) Seattle-King County Department of Public Health, Staying Happy and Healthy in Your Spa and Hot Tub, Environmental Health Division, Seattle-King County Department of Public Health, Washington, 1997.

(5) U.S. Department of Health and Human Services, *Suggested Health and Safety Guidelines for Public Spas and Hot Tubs*, HHS-99-960, Centers for Disease Control, Public Health Service, Atlanta, 1985.

Bureau of
Medicine and Surgery
Washington. D.C. 20372-5120

NAVMED P-5010-5 (Rev 1990)
0510-LP-206-6200

Manual of Naval Preventive Medicine

Chapter 5
Water Supply Ashore

DISTRIBUTION STATEMENT "A"

O51OLP2O662OO

CONTENTS

CHAPTER 5
WATER SUPPLY ASHORE

Section L GENERAL INFORMATION

5-1. Purpose.

This chapter gives public health and preventive medicine information and guidance to Department of the Navy personnel concerned with the production and surveillance of potable water at fixed shore facilities and advanced bases. Department of the Navy personnel include military and civilian members of the Navy and Marine corps.

5-2. Background.

1. The Safe Drinking Water Act (SDWA) (Public Law 93-523) was signed into law on 16 December 1974. The SDWA and later amendments direct the U.S. Environmental Protection Agency (EPA) to develop National Primary Drinking Water Regulations (NPDWR) for all public water systems from a health standpoint. As a result of this legislation, primary enforcement authority (Primacy) is to be adopted by the individual states.

2. Under the SDWA, EPA has developed National Secondary Drinking Water Regulations (NSDWR) for all public systems. Contaminants covered by NSDWR may adversely affect the aesthetic quality of drinking water. The NSDWR are not federally enforceable, as are NPDWR; rather they are intended as guidelines for the states, but may be incorporated into state law and enforced by the respective state.

3. The NPDWR are published in Title 40, Code of Federal Regulations part 141(40 CFR 141); NSDWR are published as 40 CFR 143.

4. OPNAV Instruction 5090.1, Environmental and Natural Resources Protection Manual, published procedures and requirements of SDWA and 40 CFR 141 and 143 within the Department of the Navy.

5. MEDCOM Instruction 6240.1 Series, Standards for Potable Water, set drinking water standards in the naval establishment ashore and afloat as well as outside the Continental United States. The use of forms DD 686, Fluoride Bacteriological Examination of Water, and DD 710, Physical and Chemical Analysis of Water, was also directed.

5-3. Policy.

1. In states where primacy has been granted by EPA, Navy and Marine Corps installations, classified as suppliers of water must follow substantive and procedural requirements of NPDWR to conform with the SDWA as may be published by state regulatory authorities.

2. In states and territories not having primacy, Navy and Marine Corps installations classified as suppliers of water (owner or operator of a public water system) must follow the substantive and procedure requirements of NPDWR to conform with the SDWA as administrated by the applicable EPA regional office.

3. Navy and Marine Corps installations classified as suppliers of water located outside the continental limits of the United States (CONUS) shall comply with the substantive and procedural requirements of NPDWR to conform with the SDWA, or the host country whichever is more stringent. If compliance is inconsistent with international agreements, status of forces agreements, host country laws, or cannot be achieved for any reason, requests for deviation from CONUS drinking water standards must be submitted in writing to Chief, Bureau of Medicine and Surgery (B UMED), Washington, DC 20372-5120. This request must be forwarded via the cognizant Navy Environmental

and Preventive Medicine Unit (NAVENPVNT-MEDU and the Navy Environmental Health Center (NAVENVIRHLTHCEN).

4. The establishment of drinking water system standards and monitoring requirements aboard Navy ships, both USS and USNS is a responsibility of BUMED, and are published in Chapter 6, Water Supply Afloat, of this manual.

5. Field water supply standards and monitoring requirements are a responsibility of BUMED, and are published in Chapter 9 of this manual, titled "Preventive Medicine for Ground Forces."

6. When considered necessary, BUMED may publish additional standards of water quality and monitoring requirements for Navy drinking water systems, ashore and afloat.

5-4. Responsibilities.

1. NAVFACENGCOM Engineering Field Divisions (EFDs) are responsible for:

a. Giving technical and regulatory advice to major claimants and activities concerning actions necessary for compliance with SDWA, 40 CFR 141 and those states which have primacy.

b. Conducting periodic surveys of activity water systems and reporting technical and administrative deficiencies to activities via Utility Systems Assessments (USA).

c. Determining activity needs and helping activities with respect to training and certification of water treatment plant personnel.

d. Helping activities in the development of contracts and selection of laboratory services for potable water analyses.

e. At the request of activities, negotiating with state regulatory officials to ensure equitable and realistic terms for compliance between activities, state agencies, and EPA.

f. Serving as the focal point for liaison between activities, state agencies, and EPA.

g. Checking overall regulatory compliance for activities within respective geographic regions.

h. Timely review and action with respect to public notification during incidence of activity non-compliance as required by EPA and those states having primacy.

2. The Navy Energy and Environmental Support Activity (NEESA) is responsible for:

a. Updating, as needed, the standard operating procedure for potable water monitoring.

b. Keeping EFDs and activities informed of related legislative and regulatory changes via directives from NEESA, Point Hueneme, California.

c. Giving Navy-wide defense environmental status reports to NAVFAC, CNO, major claimants and DOD as needed.

d. Helping EFDs concerning the development of water conservation projects and water contingency planning criteria. See Appendix H, H-3.1.

3. Per OPNAV Instruction 5090.1, major claimants and activity Commanding Officers with public water system are responsible for:

a. Operating, and maintaining facilities to manufacture drinking water which meets applicable standards.

b. Sampling, conducting analysis, reporting to EPA or states, and keeping records per 40 CFR 141. Copies of all records or reports sent to EPA or states must be forwarded to the proper EFD.

c. Giving notification per 40 CFR 141 to the state, or EPA and to all persons served by a community water system, if there is any failure to follow applicable substantive and procedural regulations.

d. Ensuring that water treatment plant personnel are trained and certified as required by EPA or state regulations.

4. Public Works officers (USN) and Maintenance Officers (USMC) are responsible for:

a. Developing, in coordination with the, installation medical authority, (preventive medicine department), adequate water supply treatment techniques to ensure water supply that is free of disease-producing organisms, hazardous concentrations of toxic materials, and objectionable color, odor, and taste. As a minimum, ensure the water supply meets all applicable NPDWR and the state water quality standards.

b. Pursuing, in coordination with the installation medical authority (preventive medicine department), an aggressive program to identify, isolate, and correct potential sources of contamination to the distribution system.

c. Coordinating with federal, state, and local agencies to set up a meaningful exchange of information regarding local water resources, NPDWR and NSDWR.

d. Ensuring local water treatment personnel are trained to meet levels of proficiency consistent with the operator certification requirements applicable to their location.

e. Encouraging operating personnel to attend seminars, short courses, and other formal instruction to remain abreast of new developments in water treatment practices. -

f. Maintaining quality control data to ensure NPDWR or state requirements are followed.

g. Developing a program to correct system deficiencies, and upgrading equipment as needed.

h. Collecting and shipping water samples following NPDWR, and NSDWR.

i. Notifying the installation medical authority (preventive medicine department) upon discovery that a water main break or similar occurrence has taken place.

j. Ensuring that all new mains and extensions are flushed and disinfected before placing them into service.

5. Installation medical authority (preventive medicine department). The installation medical authority, aided by the environmental health officer and/or preventive medicine technicians, has an advisory role and recommends corrective measures when any phase of water sanitation is unsatisfactory. Normally, adequate water quality can be maintained through cooperation and communication with the public works or maintenance officer. To carry out this advisory role, a water surveillance program tailored to each individual water system is required. Appendix A is a model potable water monitoring program. The water surveillance program should include but is not limited to the following:

a. Maintaining liaison with federal, state, and local regulatory authorities regarding current drinking water regulations to ensure compliance.

b. Conducting periodic sanitary surveys to locate and identify possible health hazards in the potable water system.

c. Conducting tests for halogen residuals, bacteriological quality and other tests as needed to supplement sanitary surveys.

d. Maintaining, or having access to, a copy of the plumbing diagram of the potable water, fire fighting (if separate), and sanitary waste systems.

e. Maintaining records that reflect the chemical, radiological, and microbiological quality of the installation potable water supply system.

f. Monitoring and giving recommendations, when needed, regarding the disinfection of all new additions or repairs to water mains, wells, pumps, storage tanks, and other units of the water supply system.

g. Ensuring that all types of chemical additives to potable water supplies are approved by the supplier of water, the state, and the National Sanitation Foundation (NSF) and are used in proper concentrations.

Section II. IMPORTANCE OF POTABLE WATER

5-5. General.

There are few environmental factors that affect the individual's well-being more than the availability of an adequate potable water supply. As water is a necessity to sustain life, a closely controlled and adequate potable water supply is mandatory.

5-6. Microbiological Considerations.

1. One of the greatest deficiencies of customary methods for evaluating the bacteriological quality of water is that results from tests are unknown until after the sampled water has entered the distribution system. Successful regulation of the microbiological quality of drinking water depends on the use of raw water supplies of relatively unchanging high quality. Localized contamination characteristics of leaking or broken water lines, back siphonage and cross connections are unlikely to be detected early enough to prevent exposure. Also, the low residual disinfectant maintained in the distribution system will almost certainly be overcome by such contamination. Despite the shortfalls of current microbiological monitoring techniques, it is essential that these methods continue to be used. The goals of microbiological monitoring are:

a. Provide an indicator of the effectiveness of disinfection.

b. Detect sanitary defects in the water distribution system.

2. In overseas areas, water continues to be a major consideration in the spread of disease. Special attention to water handling and treatment in these areas is needed to minimize the spread of such disease.

5-7. Physical-Chemical Considerations.

While the effects of microbiological contamination of potable water may manifest themselves in a period of days, a long-term relationship may appear when examining the effects of physical-chemical contaminants. Physical-chemical contaminants may be present in the water supply as a result of a variety of factors. Naturally occurring inorganic and organic contaminants are plentiful in the environment and are readily assimilated by water which acts as a solvent for many of them. Trace metals, other inorganic, and organics may also be assimilated by water as a result of the waste disposal and industrial actions of man. Recent trends lead one to believe that increasing concern will be generated by both the regulating agencies and the using public over the presence of both naturally occurring and man-made organics in drinking water.

5-8. Radiological Considerations

1. As with physical-chemical contaminants, minute traces of radioactivity are normally found in all drinking water. These levels vary considerably throughout the United States and the. world. The concentration and composition of these radioactive constituents depend principally on the radiochemical composition of the soil and rock strata through which the raw water has passed.

2. The long-term effects of radiological contaminants in drinking water continues to be examined. Radioactivity in water systems may be broadly categorized as either naturally occurring or man-made. Radium-226 is the most important of the naturally occurring radionuclides likely to occur in public water systems. Although radium may occasionally be found in surface water due to man's activities, it is usually found in ground water as the result of geological conditions. In contrast to radium, man-made radioactivity is widespread in surface water because of fallout from nuclear weapons testing. In some localities this radioactivity is increased by small releases from nuclear facilities (e.g., nuclear power plants, hospitals, and scientific and

industrial uses of radioactive materials). The residual radioactivity in surface waters from fallout due to atmospheric nuclear weapons testing is mainly strontium-90 and tritium.

industrial uses of radioactive materials). The residual radioactivity in surface waters from fallout due to atmospheric nuclear weapons testing is mainly strontium-90 and tritium.

Section III. WATER SOURCES

5-9. General.

1. Depending on local conditions, water supplies for installations may be obtained from any of a number of sources. Commonly used water sources include underground sources, such as springs or wells, and surface sources, such as rivers, streams or lakes. Most Navy or Marine Corps installations obtain their water supply from adjacent municipal facilities. Information concerning the development and maintenance of water sources can be found in Civil Engineering Water Supply Systems, Design Manual 5.7 (NAVFAC DM-5.7).

2. A properly conducted sanitary survey will furnish sufficient data to base the acceptance or rejection of the water as a present or potential source. This survey will be aided by chemical and bacteriological analyses, and a knowledge of the significance of the factors involved. Personnel, trained and competent in environmental engineering and the epidemiology of waterborne diseases, will conduct the sanitary survey. A sanitary survey of an existing supply will be conducted when considered essential for the maintenance of good sanitary quality. An annual sanitary survey is recommended. A sanitary survey of a new source may be made in conjunction with the collection of initial engineering data covering the development of the source.

3. Many installations have isolated water sources, such as wells and springs, for service of training areas. In many cases, these isolated water sources do not service residents and are not classified as public water systems. Water systems that meet these criteria will be classified as field sources. Sanitary control of field sources is addressed in Chapter 9 of this manual, "Preventive Medicine for Ground Forces."

5-10. Selection of Water Source.

1. To ensure the selection of an adequate source, the average daily demand and the peak demand rate must be determined. The average daily demand may be estimated to meet continuing demands during periods when surface flows and ground water elevations are reduced. The peak demand rate, including fire protection usage, may be estimated to determine plumbing needs, pressure losses, and storage requirements in order to supply enough water to all parts of a distribution system during peak demand periods. Use of peak demand data will give the system enough contact time to ensure adequate disinfection under worst-case conditions.

2. Cost Estimate. Besides capacity, consideration till also be given to the proximity and quality of the source, the expected development costs, and life of the project. Annual operating expenses that include the cost of power and chemicals, as well as personnel salaries, will be considered over the expected life of the project to arrive at a sound final selection.

3. Public Water Systems. Where practical, approved public water systems will be considered for use. An evaluation of the municipality's ability to produce enough potable water over an extended period of time will be carried out. The mission of the base or unit will be considered if the water supply depends on an outside source.

Also, the projected mobilization needs for water will be considered in evaluating a public water source. Public water systems may also be considered for their applicability as backup water systems. If two independent potable water supplies are to be interconnected, approval of the producers must be obtained. See NAVFAC DM-5.7 for more information.

5-11. Wells.

1. Ground water occurs in geologic formations called aquifers. Aquifers contain saturated permeable material which yields water to wells and springs. An aquifer serves as a transmission conduit and storage reservoir that transports water under a hydraulic or pressure gradient from recharge areas to water-collecting areas. Ground water, when available, is usually an excellent source of water supply. Such water can be expected to be clear, cool, colorless, and quite uniform in character. It is generally of better microbiological quality and contains much less organic material than surface water, but may be more highly mineralized. At present, wells serve small to medium-size installations although a system of multiple wells may be used to develop a supply for large installation. Consult NAVFAC DM-5.7 on this subject. More information may be found in NAVFAC Guide Specification NFGS 02734, Rotary-Drilled Water Wells and AWWA A-100-66, American Water Works Association Standard for Deep Wells.

2. Types of Wells. Wells are classified according to the construction method, i.e., dug, bored, driven, drilled, and jetted. Each type of well has distinguishing physical characteristics which are best used to satisfiy a particular need. NAVFAC DM-5.7 gives descriptions of particular well types and design considerations.

3. Sanitary Protection. Proper sanitary measures must be taken to ensure the purity of the water whenever ground water is pumped from a well for human consumption. Potential sources of contamination may exist either above or below ground level. Where possible, wells will be located on ground that is higher than a potential source of contamination. The area will be well drained to divert surface waters from the well and reduce the possibility of flooding. Listed below are guidelines for the sanitary protection of wells:

a. The annular space outside the casing will be filled with water-tight cement grout per EPA *Manual of Individual Water Supply Systems.*

b. For artesian aquifers, the casing must be sealed into the overlying impermeable formations to retain the artesian pressure.

c. When a water-bearing formation containing water of poor quality is penetrated, the formation must be sealed off to prevent the infiltration of water into the well and developed aquifer.

d. Every well will be provided with an overlapping watertight cover at the top of the casing, or a raised pipe sleeve to prevent contaminated water or other harmful materials from entering the well.

e. All abandoned wells must be plugged and properly sealed, as required by Federal, State, or local authority, to prevent contamination of the ground water formation and for safety reasons. The basic concept behind the proper sealing of any abandoned well is that of restoration, of the controlling geological conditions that existed before the well was drilled or constructed. If this restoration can be done, an abandoned well will not create a physical or health hazard. AWWA Standard A100-66 provides further guidance on this subject, Table 5-1 is the suggested minimum distance a well will be located from sources of contamination. In many areas, various soils and rock formations may require increased distance. State and local health departments may have requirements for various distances. A sanitary survey, conducted by qualified individuals, must be a matter of policy in the construction or drilling of any new well with nearby potential contamination sources. States and local health departments will be contacted in each area.

f. Disinfection.

(1) Drilled, jetted, bored, and driven wells must be disinfected after construction, cleaning, or the removal of equipment for repair. When the well equipment is ready for operation, the well will be flushed by pumping to waste until the water is clear. Calculate the quantity of water in the well based on the depth of water and the diameter of the casing. Introduce enough chorine solution to obtain 100 parts per million (ppm) through a clean hose that is raised and lowered to

TABLE 5-1.

Minimum distance between wells, springs, etc. and various potential sources of contamination

Potential Contamination Source	Well, spring,etc. (distance in feet)
Sewer Line	50
Septic Tank (Watertight)	50
Pit Privy	100
Disposal Field	150
Seepage pit	150
Cesspool	150

all depths of the well water. A spray nozzle will be used to disinfect the inside of the casing and the outside of the riser. Operate the pump until a distinct odor of chlorine can be detected. Check the free available chlorine (FAC). When 100 ppm FAC is obtained, allow the well to stand for 24 hours and then pump to waste until the chlorine drops to approximately 1 ppm FAC. Obtain water samples for bacteriological analysis and determine potability before putting the well in service.

(2) Dug Wells. After the casing/lining is completed and prior to placing the cover over the well, disinfection is accomplished by the following steps: Remove every-thing, (e.g., tools, equipment, and structures) that will not be part of the well. Determine the quantity of water in the well and the amount of disinfecting solution needed. Scrub the casing or lining wall with a stiff broom or brush and a 100 ppm chlorine solution. Place the well cover in position and introduce the disinfecting solution through a clean hose that is raised and lowered to all depths of the well water. Wash the outside of the pump . cylinder and piping as the unit is lowered into the well. After the pump is in place, pump the water until a distinct odor of chlorine is detected. Check the chlorine residual; when 100 ppm FAC is measured allow the well to stand for 24 hours. Pump the well until the chlorine residual is reduced to 1 ppm. Take samples for bacteriological analysis. When negative results are obtained, place the well in service.

5-12. **Springs.**

1. Springs are formed at the intersection of an aquifer with the ground surface, or by leakage of an artesian aquifer through a fracture or solution zone. Contrary to popular belief, spring water is not always of good microbiological quality. Extreme caution must be exercised in the development of springs. Generally, the same principles that apply to location, protection, development, and operation of wells apply to springs. The factors presented above for well location must also be considered when conducting a sanitary survey of a spring.

2. Protection. When used as a water source, spring water is usually captured in a small catchment reservoir to enclose and intercept as much of the spring as possible.

3. Spring Disinfection. Spring encasements will be disinfected by scrubbing the inside of the encasement above the water line with a stiff brush or broom and 100 ppm chlorine solution. When the flow can be stopped or maintained within the encasement, determine the volume of water and add enough chlorine solution to the water to obtain a 100 ppm FAC residual in the water. Let the spring stand 24 hours and discharge to waste until the FAC residual is approximately 1.0 ppm. Take samples and place in service as described for wells. When the spring flow cannot be stopped, enough chlorine must be continuously fed into the contained water in the spring encasement, near the inlet, to result in 100 ppm FAC in the outlet. This residual will be maintained for at least 24 hours.

5-13 **Surface Water Source.**

1. Surface water supplies are obtained from rivers, streams, lakes, and ponds. Because of the ease of physical and microbiological contamination of surface water, additional factors not usually associated with ground water sources, must be considered when selecting surface water sources. As a general rule, surface water should be used only when ground water sources are not economically justifiable or are of an inadequate quality or quantity.

2. Source Selection. In examining surface waters for potential use as drinking water sources, care must be exercised. A number of interrelated factors need to be considered. These include, but are not limited to, sources of pollution, hydrological studies, proposed intake location, and water uses identified for the particular water source by responsible governmental agencies. Raw water

quality should be examined and a treatment scheme proposed to make sure applicable regulations are followed and to give the best possible water supply for Navy and Marine Corps use before a final determination regarding the acceptability of the source is made.

3. Recreational Use of Surface Sources. Surface waters that are used as a potable water source may have desirable recreational qualities, e.g., fishing, boating, picnicking, and bathing. A surface water source will not be used for recreational purposes if the water treatment plant does not include filtration and if sedimentation, resulting from storage in reservoirs followed by chlorination, is the only treatment provided. Care will be exercised in determining what types of recreational activities (swimming, boating, etc.) are suitable and may be authorized for these waters. Periodic sanitary surveys, will be used to evaluate the impact of recreational uses on these water sources.

5-14. Rainwater.

1. Rain, including snow and ice can be used as a source for potable water. In most climates it only augments the supplies from other sources.

2. Because of its softness (freedom from minerals), rainwater may be used for cooking, bathing, laundry, and in boilers. Due to the absence of minerals, rainwater lacks palatability and may contain dissolved gases, dust particles, and bacteria swept from the air. In some cases, rainwater may be an important source of fresh water, (e.g., small islands and isolated areas), where ground water is salty and surface water is inadequate. Under some conditions. where usage rates are small and precipitation heavy, rain may furnish an adequate source. In many places, rain can be used to supplement other sources. Rainwater, like any water source, must be properly treated, disinfected, and handled.

3. Rainwater is collected from impervious surfaces, (e.g., roofs, concrete pavement and aprons, paved catchment areas, and barren rocks). The volume obtained depends on the size of the catchment and the amount of rainfall. An estimate of the volume (in gallons) that may be collected from an impervious surface can be made by multiplying the total catchment volume, in square feet, by one half the rainfall in inches.

4. Rainwater may be stored either above or below ground in tanks *or* containers. Potable water tank coatings must be accepted by NSF Standard No. 61 or state regulations for contact with potable water. Storing rainwater in underground cisterns reduces evaporation, keeps the water cooler and more palatable. Storage tanks must be protected from contamination by polluted surface and ground water. Storage tanks must be covered and the vents or other openings screened to protect the water from dust, dirt, mosquito breeding and the entrance of vermin.

5. The surfaces from which rain is collected are subject to contamination by birds, animals, dust and, if at ground level, by human wastes. The first rain which falls during a storm flushes these substances from the surface and must be diverted to waste. Rainwater must be considered contaminated until treated similar to other surface water sources, (e.g., filtration, coagulation, chlorination). The treated water must conform with SDWA as published by EPA in 40 CFR 141.

5-15. Snow and Ice.

1. While almost any place in the Arctic will be near water in one form or another during the year, the provision of an adequate and safe water supply for more than 50 persons is likely to be a major problem. If possible, get water from running streams or lakes instead of melting ice or snow. The melting of ice or snow uses large quantities of fuel. In winter, surface water points may freeze to a depth of 6 to 8 feet. The water source must be deep enough to prevent freezing to the bottom. Freezing of the intake can be prevented by constructing a wooden box with insulating materials to cover the opening in the ice. The raw water pump, when used, may be protected by an insulated cover or an insulated box may be constructed. In some situations, a skid-mounted, heated shelter may be constructed over the water intake to house raw water pumps and settling tanks. This water can be loaded into ski-mounted water tankers and transported to the camp where it is treated. If the water is filtered, heated buildings will be needed in winter. Standard water treatment equipment will need special heating and insulating when used in below freezing weather. Normally, water hoses may be laid directly on the snow as long as water in them is circulating.

When the pumps are stopped, water in the hoses must be drained immediately to prevent freezing. All water lines will be pitched to allow for rapid draining when the pump stops. Adequate provisions must be made to prevent freezing of stored water. Small tanks or open basins must be located in heated shelters. Outside or elevated tanks must be properly insulated.

2. In winter, if water is not available, it will be necessary to obtain water by melting snow or ice. To save fuel, use ice or the most compact snow available. Ice is preferred to snow because it will yield more water for a given volume. About 1 cubic foot of water can be obtained from melting 5 cubic feet of snow. Freshly frozen sea ice is salty, but year old sea ice has the salt leached out. Freshly frozen ice must be tested for salt content because, in some areas, where tidal action and currents are small, there is a layer of fresh water ice lying on top of the new sea ice. In some cases, this layer of salt free ice may be 2 to 4 feet in depth. Old sea ice is rounded where broken and is Likely to be pitted and have pools on it. The submerged portion of old sea ice has a bluish appearance. Fresh sea ice has a milky appearance and is angular w-here broken. Small quantities of water may be obtained by melting snow or ice over a heat source. Store the snow or ice to be melted just outside the shelter and bring it inside as needed. If necessary, keep pots of snow or ice on the stove, when not cooking, to increase the water supply. Several models of ice and snow melters are available in the supply system. They are batch units into which ice or snow is manually loaded. Most units are portable, can be operated indoors or outdoors, and can be fueled with gasoline or diesel fuel.

3. In arctic areas during the summer, surface sources are obtained and treated the same as surface supplies in other geographic regions. The milky water of a glacial stream is not harmful. Sedimentation will settle out most of the color. In summer, a muskeg area can sometimes be used as a water source. Muskeg is a resilient soil covered with bog and has a high water table. Muskeg water can be collected by building ditches.

5-16. Sea Water.

1. The sea serves as the major source of drinking water for the fleet. Ashore, the sea may be used as a water source by processing it with reverse osmosis water purification units (ROWPUS) or stills.

2. Sea water contains up to 37,000 parts per million of dissolved salts which must be removed by distillation or reverse osmosis. Since coastal water may carry considerable organic material and turbidity or be polluted with oil or other waste, it may be desirable to settle sea water before processing. The natural filtration and diluting effect of ground water may be used by processing water from shallow wells located along the shore. Since the production of potable water from brackish or fresh water is more efficient, these sources will be used as soon as the military situation permits. Hot, arid climates contain few, if any, fresh water sources large enough to support major military operations,

5-17. Bottled Water.

Bottled water may be used on Navy and Marine Corps installations in the United States or overseas as a source of drinking water. Bottled water is derived from surface or subsurface water sources, depending on the bottler, and has been shown to be of variable quality. It is commonly contended that bottled water may be of better quality than locally available public water supplies. This may not be the case. Bottled water will be only as good as the source from which obtained and the quality of treatment received. Bottled water used at Navy and Marine Corps installations must meet all the requirements of the NPDWR for physical, chemical, bacteriological, and radiological parameters.

Section IV. WATER DISTRIBUTION SYSTEMS

5-18. General.

The use of substandard facilities for water distribution will adversely affect the quality of the water being supplied even though the water leaving a treatment facility is of satisfactory chemical and microbiological quality. The safety and palatability of the water must not be impaired by defects in the system. The distribution system must not leak, and, when possible, its various mains and branches will not be submerged in surface water or ground water. Dead-end mains must be reduced to ensure effective circulation of the water. Water mains must be laid above the elevation of sanitary sewers and at least 10 feet horizontally from such sanitary sewers when they are parallel. Where a sanitary sewer crosses over a water supply, the sanitary sewer must be in pressure pipe or encased in concrete for 10 feet on both sides.

5-19. Cross-Connections.

1. Sanitary Standards. Interconnections between a potable water distribution system and a non-potable system must not be permitted. Each potable water distribution system must be periodically inspected to detect and remove all potential or existing cross-connections and to ensure that proper engineering measures, (e.g., air gaps and back-flow prevention devices) are in place and properly operating. Only through routine inspections can the control and elimination of hazards be achieved. EPA-570/9-89-007, Cross-connection Control Manual, gives excellent information on methods and devices for backflow prevention, testing procedures for backflow prevention, and administration of a cross-connection control program. NAVFACINST 11330.11 series contains a list of backflow prevention devices approved for use at Navy and Marine Corps shore installations, See Appendix B for definitions of terms used in this chapter.

5-20. Water Main Flushing and Disinfection.

1. Computation of Water Volume. Chlorine dosage needed to disinfect any unit depends on the contact time and the organic, chlorine-consuming material present. The volume of water in the unit to be disinfected must be computed before chlorine dosage can be estimated. Volumes of water contained in different sizes of pipe are listed in Table 5-2.

2. Water Main Flushing. Public works or maintenance personnel must make sure that all new or repaired mains and extensions are cleaned and flushed with potable water prior to disinfecting them and placing them into service. The purpose of this flushing is to clear all dirt, mud, and debris from the new or repaired mains. A velocity of at least 3 feet per second is needed for adequate flushing.

3. Disinfection of New, Repaired, or Accidently Polluted Water Mains.

a. When the number of gallons of water the component or system contains or will contain has been determined, the correct dosage of calcium hypochlorite (65-70 percent available chlorine) or sodium hypochlorite (5-10 percent available chlorine) may be found by referring to the "Chlorine Dosage Calculator" in Chapter 6, Water Supply Afloat, of this manual. This calculator gives the approximate dosage of chemicals needed for the desired disinfecting FAC residual. These residuals must be checked with the DPD calorimetric procedure.

b. When portable gas chlorinators are used to disinfect mains, tanks or other units, the operator's instruction manual must be consulted. The desired disinfecting residuals must be checked with the DPD calorimetric procedure.

c. Residuals and specified contact times listed in Table 5-3, are acceptable for disinfecting water mains, tanks and other appurtenances providing they are first cleaned, and flushed, as above, with potable water.

TABLE 5-2.
Volume of Water in Different Sizes of Pipe

Pipe Diameter (Inches)	Gallons Per Foot of Pipe.
2	0.16
2 ½	0.26
3	0.37
3 ½	0.50
4	0.66
6	1.50
8	2.62
10	4.10
12	5.90
14	8.04
16	10.50

(a) D^2 x .041 = gallons per foot of pipe or foot depth in a round tank. D = diameter of pipe or round tank in inches.

(b) One cubic foot of water = 7.48 U.S. gallons.

(c) One U.S. gallon = 8.34 pounds.

(d) One U.S. gallon. 3,785 ml.

TABLE 5-3.
Water Main Disinfecting Procedures

Initial FAC PPM	Contact Time Required	FAC PPM After Contact Time
50 PPM	24 hours	25 PPM
500 PPM	30 minutes	500 PPM
100 PPM	4 hours	50 PPM

d. Swabbing Repair Pipe Lengths and Fittings. Besides the flushing and disinfecting procedures described above, the interior of all repair pipe lengths and fittings w-ill be swabbed with 5 percent chlorine solution (50,000 PPM) before installing. After the repairs are completed, the repaired section must be flushed and disinfected as discussed above. The purpose of swabbing is to make sure that the residue in the joints and fittings is oxidized.

e. Post Disinfection Flushing and Microbiological Analysis. Regardless of the method used to disinfect new or repaired mains, the high concentration chlorine solutions must be flushed from the line after disinfection is complete. Samples must, then be collected downflow from the affected pipe length, or on both sides of the length if the direction of flow is variable or unknown. These samples must be checked for microbiological contamination to make sure that disinfection has been adequate. Once it has been shown that disinfection has been adequate (based upon appropriate microbiological test results), the new or repaired main can be returned to service.

5-21. **Pressure.**

1. Water distribution systems will be designed to provide an acceptable operating pressure in distribution mains, building service connections, and within buildings. Areas on high ground or with high pressure needs will have a separate high service system for maintaining pressures by pumping, backed by elevated storage, where possible.

2. No main in a distribution system will be less than 6 inches in diameter. Sizes 4 inches and smaller are to be used only upon approval of NAVFAC Headquarters. Within these constraints select the smallest pipe satisfying the following conditions:

a. Supports not less than 20 pounds per square inch residual pressure at all hydrants.

b. Supports residual pressure meeting the needs of automatic fire extinguishing systems while giving 50 percent of the average domestic and industrial flows, and the fire flow.

c. For pressure needs for graving docks see NAVFAC DM-29, Drydocking Facilities.

d. For pressure needs for berthing piers and wharves see NAVFAC DM-25, Waterfront Operational Facilities.

5-22. **Use of Non-potable Water.**

1. Non-potable distribution systems must be designed to prevent interconnection (e.g., by use of incompatible coupling devices) with a potable system. Also, the marking “NON-POTABLE” must be stenciled on the non-potable distribution system to identify it from the potable system. On shore stations, color-coding of pipes will be used to distinguish potable from non-potable systems.

Section V. POTABLE WATER STORAGE

5-23. **General.**

Potable water distribution reservoirs are necessary for fire fighting, to satisfy peak demands, to support uniform water pressure, to meet industrial needs, and to avoid continuous pumping. Storage tanks permit the operation of pumps during periods of low electrical use rates. The location of water storage tanks close to the source of supply will allow the use of the most economical pipe sizes and pumping capacities; NAVFAC DM-5.7 gives detailed information on selection of storage tanks for use on Navy and Marine Corps installations.

5-24. **Maintenance.**

1. Inspection, maintenance, and repair of storage tanks is essential to the efficient operation of a distribution system. Corrosion and scaling in storage tanks may adversely affect the quality of the stored water, and ultimately result in their structural failure. All tank coatings, including sealing compounds and other materials, must be accepted by NSF Standard No. 61 or the state having primacy, for contact with and in potable water. AWWA standards D102-78 and D101-53 contain more information on inspection, painting, and repairing of tanks, standpipes, and reservoirs.

TABLE 5-4
Color coding for shore-to-ship water connections.

a. Potable Water	Blue, Dark
b. Water Provided for Fire Protection	Red
c. Chilled Water	Striped Blue/White
d. Oily Waste-Water	Striped Yellow/Black.
e. Sewer	Gold

Non-potable systems must be physically separated from all potable water distribution systems. Whenever possible, precautions will be implemented (i.e., removal of control valves, etc.) so that only authorized personnel can operate the non-potable system.

2. Non-potable fresh or salt water supplies must be used for fire protection, flushing, and industrial uses only when the potable supply is insufficient for all requirements.

3. The use of non-potable water for personal hygiene (e.g., laundering, showering, and bathing) is prohibited for Navy and Marine Corps installations.

5-25. **Sanitary Standards for Water Storage.**

1. When potable water tanks are below ground level:

a. The overflows, (e.g., manhole covers, vents) must be located with their tops 6 inches above grade.

b. The bottom of the tank will be higher than the water table or flood water design for a minimum depth of 8 feet.

c. The ground around the tank must be sloped away from the tank to provide drainage.

d. The tanks must be located at a level which is higher than any sewers or sewage disposal systems.

e. Sewers or sewage disposal systems must be located at least 50 feet from water storage tanks.

2. All Potable Water Tanks.

a. Potable water storage tanks must be covered to prevent contamination by dust, rain, insects, animals, birds, and to discourage algae growth.

b. All vents and overflows must be screened with 20-mesh bronze insect screens. The vents must be rain proofed by using gooseneck or vent caps.

c. The construction and location of manholes must minimize the possibility of contamination. Manholes (roof hatch) will be designed with a coaming or curb 2 to 6 inches high around the opening. The manhole covers will overlap this coaming by at least 2 inches. Except when in actual use, manhole covers will be locked.

d. Overflow and drain pipes must not be directly connected to sewers.

3. Safety Precautions, All Tanks.

a. Precautions must be taken before entering the storage tank to prevent accidents due to oxygen deficient atmospheres or harmful concentration of toxic or explosive gases or vapors. The NAVSEA Gas Free Engineering Manual (NAVSEA S6470-AA-SAF-010) or other local instructions must be consulted for correct entry procedures. The local safety and health officer or an industrial hygienist (available at Naval hospitals, clinics commands and NAVENPVNTMEDUs) will be contacted for safety information on working in tanks and other confined spaces. The industrial hygienist or safety officer can outline entry procedures, specify respirators, and recommend other safety equipment necessary for tank

Water, like many other natural resources, is procured as a raw material, manufactured into a commodity suitable for use and distributed for

(confined space) entry and work.

b. Ladders, with approved safety cages will be used on all standpipes and elevated storage tanks.

c. Install a wire fence and locked gate around storage tanks prevent unauthorized entrance.

5-26. **Disinfection of Water Storage Tanks.**

1 . Potable water tanks must be disinfected before new, rehabilitated, or repaired tanks are put into service or when entered for inspection or any other reason. Tanks will also be disinfected when bacteriological evidence shows that the tank has become contaminated.

2. Disinfecting procedures may be one of the techniques described in Article 5-20 or a method which uses spraying or swabbing the walls and surfaces with a 500 PPM FAC solution. This concentration gives almost immediate disinfection. After complete application, all surfaces must be flushed with potable water. This operation must be coordinated with facility medical personnel and entry and work must follow 5-25.3.a. above.

a coaming or curb 2 to 6 inches high around the opening. The manhole covers will overlap this coaming by at least 2 inches. Except when in actual use, manhole covers will be locked.

d. Overflow and drain pipes must not be directly connected to sewers.

3. Safety Precautions, All Tanks.

a. Precautions must be taken before entering the storage tank to prevent accidents due to oxygen deficient atmospheres or harmful concentration of toxic or explosive gases or vapors. The NAVSEA Gas Free Engineering Manual (NAVSEA S6470-AA-SAF-010) or other local instructions must be consulted for correct entry procedures. The local safety and health officer or an industrial hygienist (available at Naval hospitals, clinics commands and NAVENPVNTMEDUs) will be contacted for safety information on working in tanks and other confined spaces. The industrial hygienist or safety officer can outline entry procedures, specify respirators, and recommend other safety equipment necessary for tank

Water, like many other natural resources, is procured as a raw material, manufactured into a commodity suitable for use and distributed for

(confined space) entry and work.

b. Ladders, with approved safety cages will be used on all standpipes and elevated storage tanks.

c. Install a wire fence and locked gate around storage tanks prevent unauthorized entrance.

5-26. Disinfection of Water Storage Tanks.

1 . Potable water tanks must be disinfected before new, rehabilitated, or repaired tanks are put into service or when entered for inspection or any other reason. Tanks will also be disinfected when bacteriological evidence shows that the tank has become contaminated.

2. Disinfecting procedures may be one of the techniques described in Article 5-20 or a method which uses spraying or swabbing the walls and surfaces with a 500 PPM FAC solution. This concentration gives almost immediate disinfection. After complete application, all surfaces must be flushed with potable water. This operation must be coordinated with facility medical personnel and entry and work must follow 5-25.3.a. above.

Section VI. WATER TREATMENT

Article

5-27. General.

Water, like many other natural resources, is procured as a raw material, manufactured into a commodity suitable for use and distributed for consumption. A safe and dependable water supply greatly enhances the physical and mental well-being of the individual. Each water source will be evaluated individually to determine the type and degree of treatment needed. Disinfection is a must for all water used for drinking. Disinfection alone may suffice for a deep well, where sedimentation, coagulation, flocculation, filtration, and disinfection are usually needed for most surface sources. It is the responsibility of the installation commander to make sure that the water supply is safe and palatible. The commander must also make sure that, as a minimum, the water supply meets or exceeds all applicable NPDWR and state water quality standards as required by OPNAVINST 5090.1. NAVFAC DM-5.7 gives further information on the specifics of various treatment methods.

5-28. Disinfection.

1. Potable water sources are disinfected because no other treatment process, or combination of processes, will reliably remove all disease-producing organisms from water. All acceptable methods of disinfection satisfy the following criteria. The disinfectant must:

a. Mix uniformly to provide intimate contact with microbial populations potentially present.

b. Have a wide range of effectiveness to account for the expected changes in the conditions of treatment or in the characteristics of the water being treated.

c. Not be toxic to burn-ans at the concentration levels present in the finished water.

d. Have enough residual to protect the distribution system from microbial growth and act as an indicator of recontamination after initial disinfection.

e. Be readily measured in water in the concentrations expected to be effective for disinfection.

f. Destroy virtually all disease-producing microorganisms.

g. Be practical to use and store.

2. Chlorination.

a. Under normal operating conditions, chlorination is the most widely used procedure for the routine disinfection of water. The efficiency of chlorine is affected by the following variables:

TABLE 5-5.

Chlorine-pH Relationship 100 Percent Bacteria Kill in 60 Minutes (At 72° F)

Combined Chlorine

pH	PPM
6.5	0.3
7.0	0.6
7.7	0.9
8.0	1.0
8.5	1.2
9.5	1.5
10.5	1.8

(1) The types and concentrations of the chlorine forms present.

(2) The pH of the water. At pH 6.5 and a temperature of 70° F (22° C), 0.3 ppm of combined residual causes a 100 percent bacterial kill in 60 minutes. With the same temperature and time, at pH 7.0 the combined residual must be increased to 0.6 ppm, to accomplish the same degree of bacterial kill. Data for this pH-chlorine residual relationship are presented in Table 5-5.

(3) The type and density of organisms (virus, bacteria, protozoa, helminth, or others). Of all the waterborne diseases, those caused by bacteria are the most easily prevented by chlorine disinfection. At the other extreme, certain pathogenic organisms such as the cysts of the protozoa *E. histolytica and Giardia lamblia* are the most resistant. Therefore, two parallel recommendations for chlorine residuals are often made. The lower one for bactericidal purposes and the higher one for cysticidal purposes. Available information suggests that cysticidal residuals are also viracidal. Figure 5-Cl, (Appendix C), presents data on the bactericidal and cysticidal effectiveness of free available chlorine (FAC) and combined chlorine residuals at various pH and temperature levels. Bactericidal levels are routinely used for all water supplies at Navy and Marine Corps installations in the United States since waterborne bacteria are likely to be the most prevalent organisms. Cysticidal levels will be used whenever epidemiological evidence shows the presence of nonbacterial waterborne diseases such as amebiasis, viral hepatitis A, or giardiasis.

(4) The contact time of the organisms with the chlorine.

(5) The temperature of the water. At lower temperatures, bacterial kill tends to be slower and higher residuals are needed. The effect of low temperatures is greater with combined chlorine than with free available chlorine.

(6) The concentration of substances exerting other demands on the chlorine. During disinfection, chlorine demand can be exerted by chemical compounds including those containing ammonia and the whole spectrum of organics. Many of these compounds are not effectively removed in conventional water treatment processes.

(7) Mixing of chlorine and chlorine demanding substances. The agent must be well dispersed and homogeneously mixed to assure that the contact time for disinfection is applied throughout the water supply.

(8) Appendix D discusses the safe operation of chlorination facilities,

b. Chlorine Residual. A measurable chlorine residual (FAC or combined) must be maintained in all parts of the potable water distribution system under constant circulation. This applies to Navy and Marine Corps owned and operated. supplies from ground and surface sources. This does not apply to water supplied directly to installations, leased buildings, or like facilities by a satisfactory public water supply distribution system, or from a supplier of bottled water that has been approved by the State or host nation health authority. If water supplied to an installation from an approved outside source does not have a measurable chlorine residual (FAC or combined), then this should be considered in the microbiological monitoring program of the installation medical authority. Coordination between the supplier, the public works or maintenance officer and the preventive medicine department is essential in this situation. Installation of a chlorination system for the supplied water (dechlorination) must be considered if an unhealthful situation exists. Not all disinfectants or chemicals added to purchased water will be compatible with chemicals used by the supplier. For example, the addition of chlorine (sufficient to produce FAC) to water disinfected with combined chlorine (chloramine), which delays formation of trihalomethanes (THM), may result in a product which exceeds the maximum contaminant level (MCL) for THM. Hence, the supplier and state or EPA authorities must approve chemicals added to purchased water. Dechlorination (or other chemical addition) of purchased water could make the installation commander a new supplier of water responsible for all requirements of the SDWA implemented by NPDWR. Final interpretation of whether or not an installation is classified as a supplier of water rests with the state regulatory authorities (if primacy has been granted) or with regional EPA officials (if in a nonprimacy state).

c. Chlorination in the Event of System Problems. Water from systems where sanitary, physical, or operating defects or other special hazards are known to exist, or where microbiological examinations show that satisfactory quality cannot be obtained without dechlorination, must be chlorinated to bactericidal levels shown in Table 5-6.

d. Health Effects of Chlorination. Concern has been generated over the health effects of chlorinated organics. Specifically, trihalomethanes (THMs) were placed into the maximum contaminant levels (MCLs) of NPDWR. THMs are commonly found in chlorinated drinking water, particularly in drinking waters obtained from surface water sources. THMs are formed by the reaction of naturally occurring organic substances with chlorine during drinking water treatment and distribution. Chlorination methods used by the installation may have a dramatic affect on the resultant level of THMs. As a minimum, installations obtaining their raw water from surface sources and practicing pre- and postchlorination must practice chlorination optimization. Prechlorination dosages must be reduced to the lowest level consistent, with the maintenance of a trace chlorine residual through the treatment system before postchlorination. Postchlorination will then be used to achieve needed chlorine residuals for the distribution system. Use of this technique allows for the most effective use of chlorine consistent with minimizing THM formation. Potable water trans-

TABLE 5-6

Minimum Free and Combined Bactericidal Chlorine Residual Recommended in the Event of Water System Problems

pH value	Minimum concentration of free chlorine residual after 10 minutes. ppm (mg/L)	Minimum concentration of combined chlorine residual after 60 minutes ppm (mg/L)
6.0	0.2	1.0
7.0	0.2	1.5
8.0	0.4	1.8
9.0	0.8	Not applicable
10.0	0.8	Not applicable

ferred from shore to ship will normally contain at least 0.2 ppm FAC; still, ships may be supplied with water disinfected with chloramine. In this case, the area NAVENPVNTMEDU may be contacted for instructions on testing, treatment and surveillance procedures.

e. Determination of Chlorine Residuals. Both FAC and combined chlorine residuals are applicable at facilities located in the United States and overseas. Residual FAC will be found by using the diethyl-p-phenylene, diamine (DPD) method or other EPA approved method that measures specifically for FAC. Combined chlorine residuals can be found by tests that give the total chlorine present from which the free component can be subtracted.

f. Chlorination Methods.

(1) Marginal Chlorination. In marginal chlorination, the initial chlorine demand has been satisfied but some oxidizable substances remain.

(2) Superchlorination-dechlorination. This procedure involves the application of chlorine in greater concentrations than are needed to afford acceptable bactericidal efficiency. This practice gives control over taste and odor producing substances as well as control of bacteria. Surplus chlorine is removed by dechlorination with sulfur dioxide, aeration, or activated carbon before the water enters the distribution system.

(3) Break-point chlorination. In break-point chlorination enough chlorine is applied to produce a chlorine residual composed of predominantly FAC with little or no combined chlorine present.

(4) Chloramines (Combined Chlorine and Ammonia). Depending on the population served, EPA has established the maximum contaminant limit (MCL) for trihalomethanes at 0.10 mg/1. Some raw water sources contain naturally Occurring organic substances (precursors) which react with chlorine to form THM. When chloramines, rather than free available chlorine, are used to disinfect water containing precursors, the formation of THM may be delayed until the water is used. When compared to free available chlorine, the disinfection capabilities of chloramines are less effective. A longer contact time is needed to obtain complete disinfection. Specific chloramine disinfection techniques, (e.g., ratio of ammonia and chlorine, point in treatment where chlorine is added, and point where ammonia is added) are designed for the water being treated. All proposed treatment processes, to remove THM, must be approved by the state or EPA regional office.

g. Surveillance. Water plant personnel must ensure that proper chlorine levels are maintained by regular and frequent chlorine analyses, both at the point of application and at various points in the water distribution system. Testing of treated water for chlorine residual before distribution must be accomplished at least daily, more often if the character and variability of the water supply dictates, and at least daily at various points in the water distribution system. Also, the installation medical authority must test for chlorine residuals when microbiological surveillance samples are taken (see Appendix A).

3. Other Methods. Methods of disinfection other than chlorination are being used throughout the world. Requests for the Navy and Marine Corps to use a method of disinfection other than chlorination must be forwarded to BUMED Code 03B4 via the area Navy Environmental and Preventive Medicine Unit (NAVE NPVNTMEDU). See Appendix E.

5-29. Fluoridation.

Fluorides are a small but important element in the human diet. Part of the concentration may be obtained in food, but the greatest portion will come from the potable water supply. Application of fluoride to water supplies, is recommended when the natural fluoride content of the water supply is below levels necessary for prevention of dental caries in children. The maximum contaminant fluoride level is established by the NPDWR (See Appendix F). If levels exceed NPDWR in a public water systems, control methods must be installed. Although fluorides, when taken internally in recommended concentrations, are beneficial in the prevention of dental caries, excessive amounts may produce objectionable dental fluorosis (mottling of tooth enamel). The fluorosis increases in severity as fluoride concentration rises above the NSDWR maximum contaminant level.

5-30. Corrosion Control.

1. Corrosion is a phenomenon associated with a metal and the water within a water distribution system. Corrosion in water distribution systems can be described as a two-phase process. In the first phase, the metal dissolves in the water. in the second phase, the oxide of the dissolved metal deposits itself at the corrosion site. For a metal to corrode, thus reverting to its native stable state as an oxide, is a natural tendency. Because of the differences in mineral and gas content of water supplies, some waters promote the solution of metal more rapidly than others. Some water may help to develop a mineral or oxide layer that protects against continued corrosion. Waters that generally let corrosion take place are called corrosive *waters;* and waters in which the metal does not corrode are called *noncorrosive* or *protective.* Physical factors that affect corrosion and corrosion control are temperature, velocity of water moving over the metal, changes in direction and velocity of flow, and contact with a second metal or nonmetal. Simplified indexes have been developed for determining the relative corrosiveness of the water which take into account pH, temperature, alkalinity, hardness and total dissolved solids of the water.

2. Corrosion results from the flow of electric current between two electrodes (anode and cathode) on the metal surface. These areas may be microscopic and in close proximity causing general, uniform corrosion and often red *water*, or, they may be large and somewhat remote from one another causing pitting, with or without tuberculation (small knobby prominences). Electrode areas may be induced by various conditions. Some due to the characteristics of the metal and some to the character of the water at the boundary surface.

3. A number of installations practice chemical corrosion control to increase the longevity of the distribution system. protective measures that may be necessary to control corrosion include the use of different alloys in pipe manufacture, the use of protective coatings in new main installation, and in-place coating/lining after main cleaning. Chemical control is a supplement to protective control; not a substitute for it. Chemical control cannot be expected to overcome improper flow conditions, poor design, defective materials, and faulty coatings. Polyphosphates and silicates are routinely used for chemical corrosion control. Polyphosphates have been reported to be effective in reducing corrosion by domestic waters; but, a case-by-case evaluation must be made as to the potential for effectiveness. Polyphosphates may also result in substantial phosphorus loadings in receiving wastewater treatment facilities. silicates are popular for chemical corrosion control in waters of low hardness or alkalinity.

4. Further Information. Consult AWWA Standard No. 10008 for a more detailed discussion of corrosion control.

Section VII. WATER QUALITY STANDARDS

5-31. General.

The suitability of water for any given use is determined by its quality in terms of its physical, chemical, radiological, and microbiological constituents. For water to be acceptable for human consumption it must be palatable, and, more importantly, free of any constituents that would cause adverse physiological effects. Also, it must not be destructive to the materials used in its transportation and storage. Potable water must also be suitable for the ancillary uses associated with human habitation, (i.e., personal hygiene, laundering of clothes, and dishwashing). The purpose of setting drinking water quality standards is to give a basis for the selection or rejection of a water supply intended for human consumption. It should be emphasized that the standards are maximum values and every reasonable attempt must be made to obtain water of a better quality. Interpretation of water quality data must be made only by a qualified sanitary engineer, environmental health officer, or medical officer.

5-32. Treated Water Standards.

1. General. Water made available for human consumption must be of the highest quality. Quality standards for treated water reflect the maximum values of various constituents that may be present in drinking water. Quality standards are presented in Appendix F.

2. Physical Quality. The principal physical characteristics of' water are color, odor, and turbidity. Temperature may also be considered a physical quality. The basis for physical quality standards is primarily related to consumer acceptance of the water. Waters having physical characteristics exceeding the limits in Appendix F will not, as a general rule, be used for drinking. When water of a lesser physical quality is used due to local conditions, concurrence must be obtained from the installation medical authority. Note: If water quality does not meet the standards of NPDWR (Appendix F), coordination with regulatory authorities is also needed.

3. Chemical Quality. The chemical quality of water is determined by all the chemical constituents present and any interactions between these constituents. The chemical quality of water may be described in terms of inclusive characteristics (e.g., total hardness, alkalinity, pH) or it may be described in terms of a particular cation or anion (e.g., arsenic, barium, or calcium).

a. Basis. Chemical water quality standards have been set up based on the following criteria the physiological impact and attendant effect the water will have on humans; and the consumer response to the palatability or useability of the water. The effect of a particular chemical constituent or of an inclusive characteristic of chemical quality will determine whether a mandatory limit or desirable limit is set for that chemical. Chemical constituents having deleterious physiological effects must have a mandatory limit that can not be exceeded under any circumstances. Other constituents, such as iron and manganese, have no significant adverse physiological effect, but may restrict the uses of the water for laundering of clothes. These constituents normally have a desirable limit that will not be exceeded unless a water supply of better quality is not available. Appendix F lists the chemical water quality standards for potable water.

b. Pesticides. Pesticide chemicals are toxic and must be properly stored, handled, and used to achieve the desired results without creation of unwanted toxic hazards and environmental contamination. Their persistence in the environment makes it necessary that limits be placed on the concentrations of these pesticides in drinking water. Reference limits are provided in Appendix F.

4. Microbiological Quality.

a. The microbiological quality of drinking water indicates its potential for transmitting waterborne diseases. These diseases may be caused by viruses, bacteria, protozoa, or by higher organisms. Microbiological examinations will reveal the quality of the raw water source and is an aid in deciding the treatment needed. These examinations are essential to keeping the water quality within established potability standards. The direct measurement, of pathogenic organisms in a water sample is extremely difficult. The density of these organisms is usually very low, even in a badly polluted water supply, and the analytical techniques used in their identification are complex. For these reasons, indicator organisms are used to show the presence of fecal contamination in a water supply. The most common organisms used as indicators of possible contamination are bacteria of the coliform group such as *Escherichiu coli, Klebsiella pneumoniae,* and *Enterobacter aerogenes.* These organisms occur in large quantities in the intestines of warm-blooded animals and are used as presumptive evidence of fecal contamination of water. Their occurrence, particularly in low densities, does not always mean that human fecal contamination has occurred. But, the presence of any coliform organism in treated drinking water is a sign of either inadequate treatment or the introduction of undesirable materials to the water after treatment.

b. Microbiological examinations of potable waters are usually conducted to show either the presence or absence of the coliform group. 40 CFR 141, refers to the membrane filter (MF) Technique and the Multiple Tube Fermentation (MTF) Technique. In addition EPA has recently approved two additional tests, the Autoanalysis Coilert Test, henceforth called the Minimal Media ONPG-MUG (MMO-MUG) Test, and the Presence-Absence (P-A) Coliform Test as approved methods for satisfying the NPDWR.

(1) Membrane Filter Technique. Because of its relative simplicity, the membrane filter technique has gained wide acceptance throughout the military as the preferred technique for identifying coliform organisms in drinking water. The membrane filter technique, as described in the current edition of *Standard Methods for the Examination of Water and Wastewater*, must be used except when the facility is located in a state which has been granted primacy and that state mandates the multiple tube fermentation technique. A step-by-step description is included in Chapter 6 of this manual.

(2) Multiple Tube Fermentation Technique. This method can be found in a current edition of *Standard Methods of Examination of Water and Wastewater.* This test can be used when high amounts of suspended solids in the sample limit the use of the membrane falter technique.

(3) MMO-MUG Test. The MMO-MUG Test is based on the ability of coliform bacteria to produce the enzyme beta-galatosidase which hydrolzes o-nitrophehyl-betad-glactopyranoside (ONPG) present in the chemically defined medium to form a yellow color. The formulation of the test medium poorly supports the growth of non-coliform microorganisms, the target coliform microorganisms produce the yellow color within 24 hours.

(4) Presence-Absence (P-A) Coliform Test. The P-A Test is described in *Standard Methods for the Examination of Water and Wastewater.* It is a simple modification of the multiple-tube procedure. Simplification is accomplished by the use of one large test portion (100 ml) in a single test tube.

(5) Standard Plate Count. Although the standard plate count is not directed by the EPA NPDWR, its use may be needed in conjunction with modification of the turbidity limit. This test gives the number of bacteria that can grow under the conditions of the test. It has varying significance for finished water, particularly if the plating is not completed within 6 hours after collection of the sample. The testis valuable in finding the microbiological efficiency of the various units in a water treatment process. Excessively high counts may indicate serious contamination in the system and warrant further investigation.

c. Other Microbiological Tests. Other methods exist to more specifically identify the origin of bacteriological contamination. Fecal coliform and fecal strep techniques are two commonly used methods. Specific testing procedures, such as these, are recommended for drinking water when more generalized testing yields positive results. Fecal coliform bacterial testing may be determined by using either the multiple tube or the membrane filter procedure. The membrane filter technique has been shown to have 93 percent accuracy for differentiating between coliforms from warm-blooded animals and coliforms from other sources. Fecal streptococcal group organisms can also be identified by using either membrane filter or multiple tube methods. The normal habitat of fecal streptococci is the intestines of man and animals, making these organisms one indicator of fecal pollution. Because of organism survival characteristics, other fecal indicators (fecal coliforms and total coliforms) must be used concurrently. Further discussion on the microbiology of drinking water and testing methods can be found in *Drinking Water and Health and Standard Methods for the Examination of Water and Wastewater*. Consultation on this subject can be obtained by contacting the area Navy Environmental and Preventive Unit (NAVENPVNTMEDU).

5. Radiological Quality.

a. Radioactive elements can appear in water supplies as a result of naturally occurring contamination. Radioactive elements can also enter water from indiscriminate disposal of hospital or industrial radionuclides as well as a result of leakage from reactors.

b. Radiological Standards. Radiological water quality standards are based on the premise that radiation has an adverse physiological effect on humans and any unnecessary exposure must be avoided. The physiological effects that are associated with overexposure to radiation demands the rejection of any treated water containing excess quantities of radionuclides. Proper treatment methods will provide drinking water of desired radiological quality in most cases. The NPDWR standards for radionuclide are summarized in Appendix F.

dicators (fecal coliforms and total coliforms) must be used concurrently. Further discussion on the microbiology of drinking water and testing methods can be found in *Drinking Water and Health and Standard Methods for the Examination of Water and Wastewater.* Consultation on this subject can be obtained by contacting the area Navy Environmental and Preventive Unit (NAVENPVNTMEDU).

5. Radiological Quality.

a. Radioactive elements can appear in water supplies as a result of naturally occurring contamination. Radioactive elements can also enter water from indiscriminate disposal of hospital or industrial radionuclides as well as a result of leakage from reactors.

b. Radiological Standards. Radiological water quality standards are based on the premise that radiation has an adverse physiological effect on humans and any unnecessary exposure must be avoided. The physiological effects that are associated with overexposure to radiation demands the rejection of any treated water containing excess quantities of radionuclides. Proper treatment methods will provide drinking water of desired radiological quality in most cases. The NPDWR standards for radionuclide are summarized in Appendix F.

Section VIII. WATER QUALITY SURVEILLANCE

Article

5-33 OBJECTIVES

The objectives of water quality surveillance are to make sure that the quality of drinking water on Navy and Marine Corps installations meets the minimum health standards of NPDWR and any additional standards mandated by BUMED, to assure that the distribution system is protected from undue corrosion or scaling and that economically thorough treatment is carried out by the treatment plant. These objectives are met by a program of water quality monitoring under the direction of NAVFACENGCOM in coordination with BUMED. Consult Appendix F for treated water quality standards.

5-34. Surveillance Sampling.

1. Treated Water at Navy and Marine Corps Owned and Operated Facilities. Surveillance sampling to meet the goals of the preceding paragraph must be carried out on treated waters supplied by the installation at Navy and Marine Corps owned or operated facilities. Treated water is defined to include any treatment of raw surface or ground water sources and may include dechlorination or fluoridation of purchased water. Also, Navy and Marine Corps installations which sell or give treated water to non-department of the Navy military authorities or to civilian communities are considered suppliers of water and must perform surveillance monitoring services, for the areas covered by their treated waters, following the NPDWR and NSDWR, as applicable. A "supplier of water" owns or operates a public water system. Compliance with state drinking water regulations or NPDWR requires surveillance monitoring. Drinking water must be analyzed at laboratories certified by state regulatory agencies (in states having primacy) or by the Regional EPA office (in states not having primacy).

a. Surveillance Responsibility. The installation commanding officer is responsible for sampling, conducting analyses, reporting to EPA or states and keeping records per the NPDWR. The public works or maintenance department is normally assigned responsibility for collecting samples and doing laboratory analyses, The installation medical authority (preventive medicine department) must work closely with the certified laboratory, the water supplier, and the federal, state, or local regulatory authority. The medical authority will review results of the analyses and make recommendations to assure compliance with NPDWR and NSDWR. All water analyses must be conducted by an EPA or state certified military or civilian laboratory. NAVFACENGCOM helps activities in the development of contracts and selection of laboratory services for potable water analyses.

b. Physical, Inorganic, Organic and Radiological Surveillance.

(1) Surface Water Sources. Analyses for the inorganic chemicals specified in the NPDWR must be conducted at yearly intervals for community water systems. Analyses for the specified organic chemicals, excluding trihalomethanes, must be at a frequency specified by the state but never less often than 3 year intervals for community water systems. Trihalomethanes must be monitored quarterly as directed by the states having primacy or EPA. For community water systems, analyses for radiological activity must be conducted at least once every 4 years. Initial radiological analysis must be conducted on either the analyses of an annual composite of four consecutive quarterly samples or the average of the analyses of four samples obtained at quarterly intervals. Once an acceptable data base is available, the state may modify the sampling scheme. Likewise, where there is reason for concern, the state may decrease monitoring intervals. Water must be analyzed for man-made radioactivity in those systems serving over 100,000 persons or those systems specified by the state. Few, if any Navy or Marine Corps systems will be affected by this portion of the NPDWR; but, guidance and sampling mandates of the various states must be followed. Turbidity analysis must be conducted at least once daily for both community and noncommunity systems using the Nephelometric Method on a sample collected at an entry point into the distribution system (refer to the current edition of *Standard Methods for the Examination of Water and Wastewater.* Turbidity analysis is the public works or maintenance officer's responsibility. Nitrate analysis is the only inorganic analysis directed for noncommunity systems; but, additional analyses may be specified by the state. Organic and radiological analyses are not directed for noncommunity systems.

(2) Ground Water Sources. Community water systems using only ground water sources must have the inorganic analyses conducted at least every third year per the NPDWR. Organic analyses must be conducted as specified by the state. Analyses for natural radioactive substances must be as specified for surface water sources. Analyses of ground water sources for man-made radioactive substances must be as specified by the state. Turbidity need not be monitored for ground water sources. Nitrate analyses for ground water supplied noncommunity systems must be conducted as specified by the state.

c. Microbiological Surveillance. For community water systems, the, number of samples collected from the installation distribution systems will be no less than that required by the NPDWR for the population served. For noncommunity water systems, at least one microbiological sample per month must be collected unless increased by a state mandate.

d. Supporting Laboratories. Analyses of samples from public water systems in the U.S. must be conducted by laboratories certified by EPA or the state. Measurements for turbidity and free chlorine residual may be conducted by anyone acceptable to the state. Technical help for radionuclide analyses may be obtained from the USAF Occupational and Environmental Health Laboratory, Brooks Air Force Base, Texas and the U.S. Army Environmental Hygiene, Agency, Aberdeen Proving Grounds, Maryland. This service may be used only if state certified laboratories are not available. Approval to use these laboratories must be obtained from NAVFACENGCOM, Code 1122 via the cognizant EFD.

2. Treated Water at Navy and Marine Corps Owned and Contractor Operated Facilities.

a. Surveillance Responsibility. The installation commanding officer is responsible for surveillance monitoring (see Appendix (G). Actual collection and submission of samples is normally assigned to the public works or maintenance officer. The Medical Department, (preventive medicine department) will routinely review surveillance monitoring results to see that all NPDWR or corresponding state drinking water regulation mandates are met. In cases where the contractor must accomplish NPDWR or corresponding state drinking water regulations, the installation medical authority (preventive medicine department) must institute a parallel surveillance program to include the following:

(1) Verify that a potable water quality survey is done every 3 years.

(2) Conduct medical bacteriological surveillance of the distribution system per Appendix A, Section A-7.

(3) Conduct monthly reviews of drinking water records.

(4) Make sure that the sampling and preservation procedures, discussed in Article 5-38, are followed when samples are taken for medical surveillance testing.

3. Purchased Water.

a. NPDWR and NSDWR Application. The NPDWR and NSDWR will apply to Navy and Marine Corps purchased water if:

(1) The system has collection and treatment facilities.

(2) The purchased water is obtained from a water system to which NPDWR and NSDWR do not apply.

(3) Water is sold for potable use.

(4) The purchased water is supplemented with water from Navy or Marine Corps sources.

(5) Additional treatment, (e.g., rechlorination, fluoridation, or addition of chemicals for corrosion control) is conducted.

(6) Note: Final interpretation of whether or not an installation is classified as a "supplier of water" rests with the state (for states that have assumed primacy) or EPA region (for states that have not assumed primacy). If final determination is made that an installation which purchases its potable water is a "supplier of water," then that installation must comply with the requirements of NPDWR and NSDWR. Suppliers of water are required by the NPDWR and NSDWR to conduct physical, inorganic, organic, radiological, and microbiological monitoring of the water system.

b. Surveillance Responsibility. The installation medical authority must coordinate with the supplier of water to see that the requirements of NPDWR and NSDWR are being fulfilled. Independent analyses are not needed for physical, chemical, and radiological contaminants if the installation medical authority (preventive medicine department) is satisfied that the federal, state and local mandates are being fulfilled. The installation medical authority will conduct bacteriological surveillance of the purchased water in accordance with Appendix I.

4. Bottled Water. Bottled water is a type of purchased water. Bottled water must comply with the requirements of NPDWR and NSDWR for physical, chemical, bacteriological, and radiological contaminants. The installation medical authority is responsible for verifying the quality of this supply source and must approve, from a medical perspective, the purchase of a bottled water for distribution on an installation. A program of microbiological monitoring of bottled drinking water must be instituted if this source is used.

5-35. **Surveillance Sampling Overseas.**

All Navy and Marine Corps installations located outside CONUS must maintain the same drinking water standards as prescribed for CONUS installations. Any requests for deviation from CONUS drinking water standards must be submitted in writing to BUMED via the area NAVENPVNTMEDU and The Navy Environmental Health Center (NAVENVIRHLTHCEN).

5-36. **Military-Unique Chemicals and Other Potentially Hazardous Materials.**

The area NAVENPVNTMEDU must be consulted immediately upon suspicion of contamination of a water source by military-unique chemicals or other potentially hazardous materials. The NAVENPVNTMEDU can arrange analysis from laboratories capable of performing the necessary tests.

5-37. **Operational Surveillance.**

Besides the surveillance sampling program previously mentioned, water treatment personnel will collect additional samples to provide quality control for any treatment processes that are used. Examples of this type of analyses are: coagulant demand, turbidity, color, odor, chlorine residual, fluoride, iron, manganese, pH, temperature, hardness, total alkalinity, and total dissolved solids. The latter five analyses are needed for the determination of the Langlier Index (See Appendix H, H- 8.10.) which is used as an indicator of corrosive properties of treated water. Operational sampling will be done as often as necessary to assure the maintenance of effective treatment control and to reduce the cost of treatment.

5-38. **Procedures for Sampling and Preservation**

1. Physical, Inorganic, Organic and Radiological Surveillance. For those installations having public water systems, sampling and sample preservation guidelines are contained in NPDWR and NSDWR, or corresponding state drinking water regulations. Installations not having public water systems must contact the supporting laboratory or activity to verify laboratory capability, appropriateness of the analytical request, sampling techniques, and sample preservation guidelines.

2. Microbiological Surveillance. Sampling and preservation guidelines for installations not having public water systems must be identical to those stated in NPDWR and NSDWR, or corresponding state regulations. As a general guide, Appendix I presents the sampling techniques to be used in determining the microbiological quality of water. Samples collected for microbiological analysis must be examined as soon as possible after collection. Ideally, samples will not be held for more than 6 hours between collection and analysis. The exception to this rule is for samples mailed from distant installations. These samples may be held for Up to 30 hours. Samples must be shipped in ice. This is important because of the extensive changes that take place in the bacterial flora even though the samples are stored at temperatures as low as 4° C.

3. Sampling Location Plan. A map of the installation water distribution system, showing all sampling points, must be kept by the installation medical authority. Only those samples of water distributed for drinking and culinary purposes will be used in the evaluation of potability. Sampling points, such as dining facilities, hospitals, barracks, and residential and administrative areas will be chosen to be representative of principal use. Hot water faucets, mixing faucets fixtures that are leaking, drinking fountains, fire hydrants, or outlets connected to dead end sections of the distribution system will be spot checked, but need not be the subject of routine monitoring. On those installations where more than one independent distribution system is in use, each system must be considered as separate and distinct for the purpose of calculating the number and frequency of samples to be drawn.

4. Analytical Methodology.

a. Physical, Inorganic, Organic and Radiological Surveillance. The NPDWR, NSDWR, and corresponding state drinking water regulations contain analytical methods for surveillance of public water systems. For other types of surveillance, the current edition of *Standard Methods For The Examination of Water and Wastewater* will be used.

b. Microbiological Surveillance. For those installations having public water systems, approved analytical methods are contained in NPDWR or corresponding state drinking water regulations. The MF, the MTF, the MMO-MUG and then P-A tests are approved methods. The standard sample for the examination of finished water is 100 ml. The MF, because of ease, maybe used by Navy and Marine Corps facilities unless the facilities are located in states which require another approved total coliform test. The standard sample using the MF technique is 100 ml. This 100 ml sample may be distributed among multiple membranes if necessary. For other types of surveillance, not governed by drinking water regulations, the MF technique can be used.

5-39. **Reporting and Record Keeping.**

The NPDWR directs operators of public water systems to give to the regulatory agency chemical and microbiological results within 40 days following the analyses. Records of microbiological analysis must be kept for 5 years, and chemical analysis records must be kept for 10 years. Other information on sample collection and laboratory analyses must also be kept. Consult the NPDWR, subpart D, or corresponding state regulations for complete reporting and record keeping details.

5-40. **Remedial Action.**

1. Suspected Bacteriologic Contamination. Appendix J presents information as to the type of action to be taken when bacteriological contamination is suspected. The important fact to remember is not to unduly alarm the consumer. Overreaction on the part of responsible personnel results in increasing the magnitude of the suspected problem, often to an extent entirely out of proportion to the seriousness of the problem. If coliform positive samples are found and the required follow-up samples are also positive, then consultation is recommended with the area NAVENPVNTMEDU. Specialized testing, to indicate the source of contamination, maybe called for.

2. Noncompliance with NPDWR. (NSDWR for Fluoride)

a. If a particular sampling point has been confirmed to be in noncompliance with the standards listed in Appendix F, the installation commander will:

(1) Give notification, per NPDWR, to the state or EPA and to all persons served by the community water system. DD Form 1535, request/approval for Authority to Advertise, will be completed and sent along with a copy of the proposed notification, to the NAVFACENGCOM, Engineering Field Division (EFD), Environmental Branch, for approval before the publication of the notice of non-compliance.

(2) Provide alternative drinking water until the supply is again known to be safe.

b. For those installations operating public water systems, there is a public notification requirement under NPDWR when Maximum Contaminant Levels (MCLs) are exceeded. Public notification is called for when applicable testing procedures are not followed; schedules of a variance or an exemption are not followed; when a variance or an exception is granted; and when monitoring is not done. Public notification is explained in detail in NPDWR, subpart D, or corresponding state drinking water regulations.

tamination is suspected. The important fact to remember is not to unduly alarm the consumer. Overreaction on the part of responsible personnel results in increasing the magnitude of the suspected problem, often to an extent entirely out of proportion to the seriousness of the problem. If coliform positive samples are found and the required follow-up samples are also positive, then consultation is recommended with the area NAVENPVNTMEDU. Specialized testing, to indicate the source of contamination, maybe called for.

2. Noncompliance with NPDWR. (NSDWR for Fluoride)

a. If a particular sampling point has been confirmed to be in noncompliance with the standards listed in Appendix F, the installation commander will:

(1) Give notification, per NPDWR, to the state or EPA and to all persons served by the community water system. DD Form 1535, request/approval for Authority to Advertise, will be completed and sent along with a copy of the proposed notification, to the NAVFACENGCOM, Engineering Field Division (EFD), Environmental Branch, for approval before the publication of the notice of non-compliance.

(2) Provide alternative drinking water until the supply is again known to be safe.

b. For those installations operating public water systems, there is a public notification requirement under NPDWR when Maximum Contaminant Levels (MCLs) are exceeded. Public notification is called for when applicable testing procedures are not followed; schedules of a variance or an exemption are not followed; when a variance or an exception is granted; and when monitoring is not done. Public notification is explained in detail in NPDWR, subpart D, or corresponding state drinking water regulations.

Section IX. CONTINGENCY PLANNING

5-41. General.

The management and operation of a water supply, treatment, and distribution system are complex tasks directed towards guaranteeing a continuous supply” of high quality water for domestic and industrial use. This chapter is concerned with highlighting the need for contingency planning that can aid an installation in maintaining an uninterrupted water supply during natural and man-made disasters.

5-42. Points to Consider.

When making contingency plans, coordination between the public works or maintenance officer and the installation medical authority is essential. Specific responsibility must be defined for each organization. other factors to be considered include:

1. Create a priority of service listing for major areas and users on the installation.

2. Locate major valves and backflow prevention devices for isolating damaged areas to prevent the spread of contamination.

3. Find alternate water storage, purification, and power generation equipment, (e.g., use of swimming pool treatment facilities, use of field water treatment equipment from the Marine Corps or construction battalions, Army and Air Force active and reserve components).

4. Setup procedures to elevate disinfectant (chlorine) residual levels to give added disinfectant capability.

5. Setup procedures for notification of installation residents and work force of emergency potable water considerations.

6.1 through 5 above are not intended to be all inclusive. These paragraphs show potential areas that need further analysis on a case-by-case basis.

5-43. **Additional Information.**

For help in developing contingency plans to cope with an emergency or disaster, consult the AWWA Manual M19 and NEESA 1-38, Water Management Contingency Planning Criteria.

5-44. References Appendix H is a list of reference materials used in the preparation of this chapter.

5-43. **Additional Information.**

For help in developing contingency plans to cope with an emergency or disaster, consult the AWWA Manual M19 and NEESA 1-38, Water Management Contingency Planning Criteria.

5-44. References Appendix H is a list of reference materials used in the preparation of this chapter.

APPENDIX A

MODEL POTABLE WATER MONITORING PROGRAM FOR THE INSTALLATION MEDICAL AUTHORITY

A-1. Coordinate liaison with applicable federal, state, and local regulatory agencies for information and guidance with the medical monitoring program. The area NAVENPVNTMEDU can be a source of guidance on this subject.

A-2. Write a SOP detailing the potable water monitoring program to be followed by your branch or activity.

A-3. Keep a updated list of all water sources including the type, location quality, and quantity of each. Maintain information on the treatment provided to each water source.

A-4. Keep a current set of plans of the water distribution system.

A-5. Keep records of surveys, analyses, actions and other information pertinent to the sanitary surveillance of the potable water system.

A-6. Keep copies of all regulatory agency and Navy/Marine Corps water regulations, instructions, and orders.

A-7. Collect samples for bacteriological analyses as directed, (e.g., after system or main disinfection, consumer complaints, special samples for studies in connection with positive EPA or state samples, monthly spot checks from points representative of major sections of the distribution system, etc.).

A-8. Do chlorine residual tests to investigate water problems (e.g., taste and odor, consumer complaints, and with each above bacteriological analyses).

A-9. Review the results of all EPA or state potable water analyses done at certified water laboratories and local analyses performed in A-7 and A-8 above.

A-10. Inspect the water source, treatment plant (when located on the installation), and the storage and distribution systems at least quarterly.

A-Il. Approve or ensure that all chemical additions and concentrations to potable water supplies are as listed in NSF Standard No. 60. Also, make sure that water tank coatings, water hoses, and other materials used in, or in contact with, potable water are listed in applicable NSF Standards.

A-12. Where applicable, inspect the water treatment plant laboratory and review analytical procedures to assure compliance with Standard Methods quarterly.

A-13. Set up a program to inspect for and do away with cross-connections.

A-14. Coordinate with the facilities public works or maintenance officer to:

1. Give feedback on inspections and analyses.
2. Make sure that medical department (preventive medicine department) personnel are told of distribution system breakage, modification, flushing, shutdown, or when component or main disinfection occurs.
3. Insure that adequate chlorine residuals are maintained in all portions of the distribution system under constant circulation.
4. Develop contingency plans for natural or manmade disasters.

A-15. Pursue an aggressive continuing education program in health related potable water training.

A-16. Give applicable command environmental health guidance found in OPNAV, NAVFAC, and BUMED instructions, appropriate state drinking water regulations, 40 CFR, and this publication.

tion program in health related potable water training.

A-16. Give applicable command environmental health guidance found in OPNAV, NAVFAC, and BUMED instructions, appropriate state drinking water regulations, 40 CFR, and this publication.

APPENDIX B
DEFINITIONS

B-1. AIRGAP A physical separation sufficient to prevent backflow between the free-flowing discharge end of the potable water system and any other system. An airgap is physically defined as a distance equal to twice the diameter but never less than one (1) inch.

B-2. AQUIFER A permeable, water-bearing geologic formation.

B-3. BACKFLOW The flow of water or other liquids, mixtures, or substances into the distribution pipes of a potable system of water from any source or sources other than its intended source. Backsiphonage is one type of backflow.

B4. BACKFLOW PREVENTER A device or means designed to prevent backflow or backsiphonage. Most commonly categorized as air gap, reduced pressure principle device, double check valve assembly, pressure vacuum breaker, atmosphere vacuum breaker, hose bib vacuum breaker, residential dual check, double check with intermediate atmosphere vent, and barometric loop.

B-5. BACKSIPHONAGE Backflow resulting from negative pressures in the distribution pipes of a potable water system.

B-6. BREAK-POINT CHLORINATION The application of chlorine to produce a residual of free available chlorine with little or no combined chlorine present.

B-7. CHECK VALVE A self-closing device which is designed to allow the flow of fluids in one direction and to close if there is a reversal of flow.

B-8. COMBINED AVAILABLE CHLORINE The chlorine products formed by the reaction of equilibrium products of ammonia with the equilibrium products of chlorine to form chloramines. Combined available chlorine has significantly less disinfecting power.

B-9. COMMUNITY WATER SYSTEM A public water system that serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

B-10. CONTAMINANT A substance that will impair the quality of the water to a degree that it creates a serious health hazard to the public leading to poisoning or the spread of disease.

B-1l. CROSSOVER POINT Any point or points where a potable water main makes contact or crosses over or under a non-potable liquid conduit (sewer, nonpotable water supply).

B-12. CROSS-CONNECTION Any actual or potential connection between the public water supply and a source of contamination or pollution.

B-13. DISINFECTION The act of inactivating the larger portion of microorganisms in or on a substance with the probability that all pathogenic bacteria are killed by the agent used.

B-14. EPA The United States Environmental Protection Agency.

B-15. FIELD WATER SUPPLY SYSTEM That assemblage of collection, purification, storage, transportation, and distribution equipment and personnel to provide potable water to field units in training and actual deployment environments.

B-16. FINISHED WATER Treated Water.

B-17. FIXED INSTALLATION An installation that, through extended use, has gained those structures and facilities not initially found or intended for use at a "temporary" facility, (e.g., paved roads, fixed electrical distribution systems, fixed water treatment facilities, and underground distribution lines).

B-18. FLOOD-LEVEL RIM The edge of the receptacle from which water overflows.

B-19. FREE AVAILABLE CHLORINE Chlorine available (after chlorine demand has been satisfied) in the. forms of hypochlorous acid and hypochlorite ions.

B-20. HEALTH HAZARDS Any condition, including any device or water treatment practice, that may create an adverse effect on a person's well-being.

B-21. INSTALLATION MEDICAL AUTHORITY In medical commands, the Commanding Officers and Officers in Charge; in other than naval medical commands, the medical officer or medical department representative; and in the Marine Corps, the installation surgeon.

B-22. MARGINAL CHLORINATION Application of chlorine to produce the desired total chlorine residual without reference to the amounts of free or combined chlorine present.

B-23. MAXIMUM CONTAMINANT LEVEL The maximum permissible level of a contaminant in water that is delivered to the free-flowing outlet of the ultimate user of a public water system except for turbidity where the maximum permissible level is measured at the point of entry to the distribution system. Substances added to the water under circumstances controlled by the user, are excluded ii-em this definition.

B-24. MEDICAL BACTERIOLOGICAL SAMPLING Independent bacteriological sampling, conducted by the medical department, of the water distribution system to augment sampling required by NPDWR.

B-25. MUST Indicates a requirement that is necessary or essential to meet current accepted standards of protection of federal rules and regulations.

B-26. NONCOMMUNITY WATER SYSTEM A public water system that is not a community water system.

B-27. NON-POTABLE WATER Water that has not been examined, properly treated, or approved by proper authorities as being safe for domestic consumption. All waters are considered non-potable until declared potable.

B-28. PALATABLE WATER Water that is pleasing to the taste and is significantly free from color, turbidity, and odor. Does not imply potability.

B-29. POTABLE WATER Water that has been examined and treated to meet appropriate standards and declared fit for domestic consumption by responsible installation medical authorities.

B-30. PRIMACY Primary enforcement authority. A state government has primary enforcement authority under the Safe Drinking Water Act. primacy is delegated to the state by the EPA Administrator. Before assuming primacy, the state shall establish drinking water regulations no less stringent than the present NPDWR.

B-31. PUBLIC WATER SYSTEM A system for the provision to the public of piped water for human consumption. A system that has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year. This term includes:

1. Any collection, treatment, storage, or distribution facility under the control of the operator of such systems and used primarily in connection with such system.

2. Any collection or pretreatment storage facilities not under such control that are used primarily in connection with such system. A public water system is either a “community water system” or a “noncommunity water system.”

B-32. RAW WATER

1. Untreated water usually the water entering the first treatment unit of a water treatment plant.

2. Water used as a source of water supply taken from a natural or impounded body of water, such as a stream, lake, pond, or a ground water aquifer.

B-33. REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTER An assembly of differential valves and check valves including an automatically opened spillage port to the atmosphere designed to prevent backflow.

B-34. SANITARY DEFECTS Conditions that may cause the contamination of a water supply during or after treatment. These include connections to unsafe water supplies, raw water bypasses in treatment plants, plumbing fixtures improperly designed and installed, and leaking water and sewer pipes in the same trench.

B-35. SANITARY SURVEY An on site review of the water source, facilities, equipment, operation, and maintenance of a public water system for evaluating adequacy of such source, facilities, equipment, operation, and maintenance for producing and distributing safe drinking water.

B-36. SHOULD Indicates an advisory recommendation that is to be applied when practicable.

B-37. SPRING A spring is a concentrated discharge of ground water appearing at the ground surface.

B-38. STANDARD SAMPLE The aliquot (100 ml) of finished drinking water that is examined for the presence of coliform bacteria.

B-39. SUPERCHLORINATION The application of chlorine in dosages far in excess of the chlorine demand for disinfection.

B-40. SUPPLIER OF WATER Any person

who owns or operates a public water system.

B-41. TOTAL AVAILABLE CHLORINE The sum of the chlorine forms present as free available chlorine and combined available chlorine.

B-42. TREATED WATER Water that has undergone processing such as sedimentation, filtration, softening, disinfection, etc., and is ready for consumption. Included is purchased potable water that is retreated (chlorinated, fluoridated, etc.).

B-43. TRIHALOMETHANES (THM) A class of organic compounds, commonly found in chlorinated or brominated drinking waters. THM are formed by the reaction of naturally occurring organic substances (commonly called precursors) with chlorine or bromine during water treatment operations and distribution. The four organic halogen compounds that make up total trihalomethanes are: Trichloromethane (chloroform), bromodichloromethane, dibromochloromethane and tribromomethane (bromoform).

B-44. WATER QUALITY The chemical, physical, radiological, and microbiological characteristics of water with respect to its suitability for a particular purpose.

B45. VACUUM BREAKER, NONPRESSURE TYPE A device or means to prevent backflow designed not to be subjected to static line pressure.

B-46. VACUUM BREAKER, PRESSURE TYPE A device or means to prevent backflow designed to operate under conditions of static line pressure.

who owns or operates a public water system.

B-41. TOTAL AVAILABLE CHLORINE The sum of the chlorine forms present as free available chlorine and combined available chlorine.

B-42. TREATED WATER Water that has undergone processing such as sedimentation, filtration, softening, disinfection, etc., and is ready for consumption. Included is purchased potable water that is retreated (chlorinated, fluoridated, etc.).

B-43. TRIHALOMETHANES (THM) A class of organic compounds, commonly found in chlorinated or brominated drinking waters. THM are formed by the reaction of naturally occurring organic substances (commonly called precursors) with chlorine or bromine during water treatment operations and distribution. The four organic halogen compounds that make up total trihalomethanes are: Trichloromethane (chloroform), bromodichloromethane, dibromochloromethane and tribromomethane (bromoform).

B-44. WATER QUALITY The chemical, physical, radiological, and microbiological characteristics of water with respect to its suitability for a particular purpose.

B45. VACUUM BREAKER, NONPRESSURE TYPE A device or means to prevent backflow designed not to be subjected to static line pressure.

B-46. VACUUM BREAKER, PRESSURE TYPE A device or means to prevent backflow designed to operate under conditions of static line pressure.

APPENDIX C
PRINCIPAL WATERBORNE DISEASES OF CONCERN WITHIN CONUS

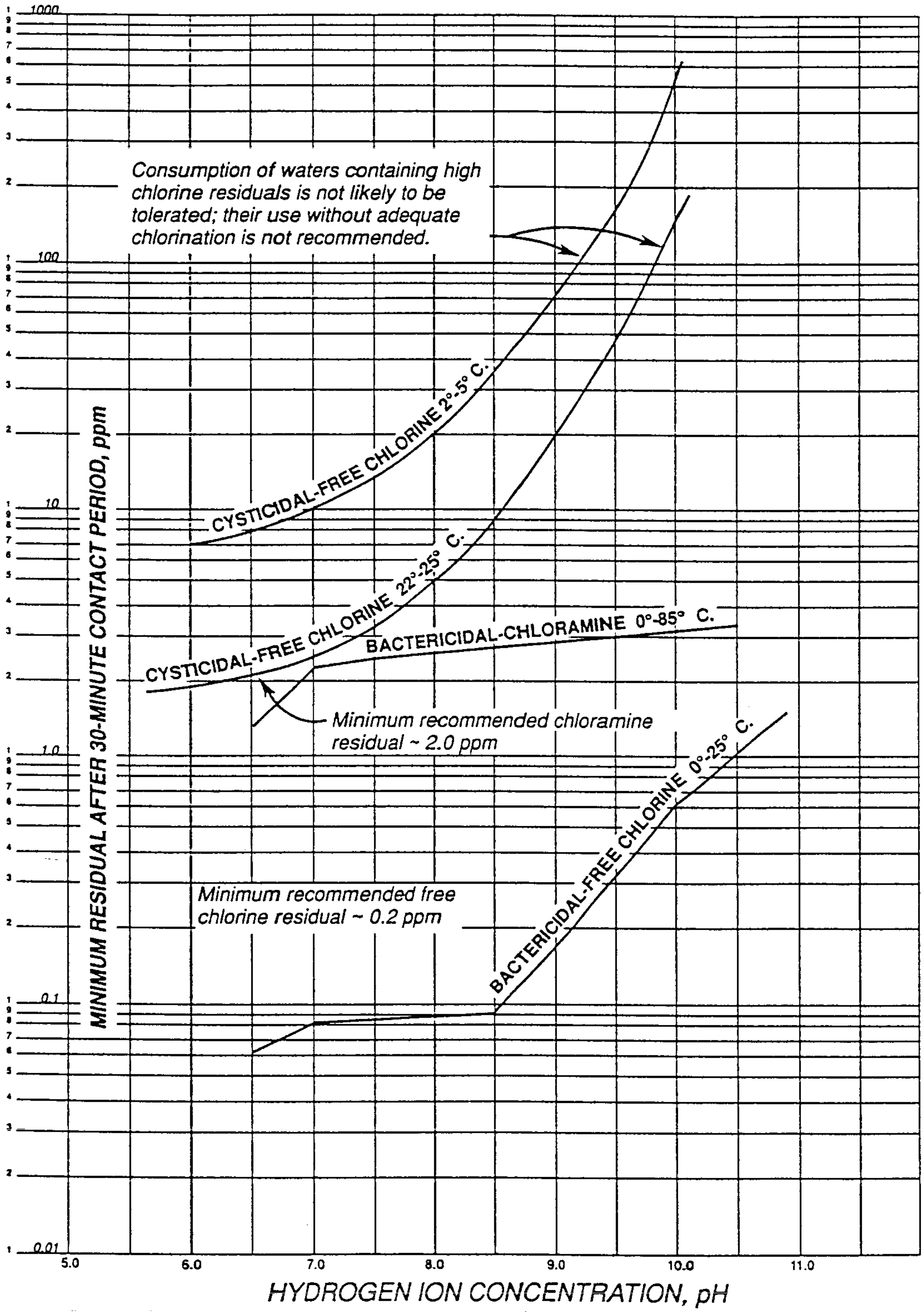
C-1. The principal diseases contracted by man from ingesting contaminated water are gastroenteritis, (both viral and bacterial), giardiasis and other protozoal diseases, typhoid fever, salmonellosis, shigellosis, and viral hepatitis. Also, the larvae of certain schistosomes of birds and mammals can penetrate human skin and cause a dermatitis upon exposure to raw water in the Great Lakes of North America. These schistosomes do not mature in man; the resulting dermatitis is sometime known as “swimmer’s itch.”

C-2. The transmission of these diseases is not limited only to water. With the exception of the bird or mammal schistosome, they all enter man by the fecal-oral route. The impact of waterborne disease may be catastrophic since a single contaminated water supply may affect an entire population rather than isolated individuals. The incidence of waterborne outbreaks is on the increase, possibly due to accident, negligence, or a drastic change in conditions at an existing treatment plant.

C-3. Figure 5-C 1 shows a single line for bactericidal chlorine residuals over the temperature range 0°—2° C. The same is true for bactericidal chloramine residuals. Also shown are curves for cysticidal residual for free chlorine for the low and normal temperature ranges.

C-4. NAVMED P-5010-6, Water Supply Afloat, discusses disinfection of water manufactured on Navy ships both on the open sea and from areas where amebiasis or hepatitis is endemic. NAVMED P-5010-9 discusses water supply procedures for field units of the Navy and Marine Corps. *Control of Communicable Diseases in Man,* NAVMED P-5038, published by the American Public Health Association discusses the infectious agents, reservoirs, incubation periods, and methods of control for waterborne diseases found both in CONUS and in overseas areas.

FIGURE 5-C1 — Minimum 30 minutes free chlorine and chloramine residuals for naturally clear or filtered water



APPENDIX D

SAFE OPERATION OF CHLORINATION FACILITIES

D-1. Chlorine storage and use areas must be isolated from other work areas and kept in a dry condition. All chlorine cylinders must be secured to prevent rolling or falling. Empty containers will be segregated from full containers and tagged. Cylinders must not be stored near heat sources, or areas of elevated temperature. Storage will be above ground in a well-ventilated area separated from other occupied areas by a gas tight partition. “

D-2. The room must be continuously ventilated at a rate of one air change every 2 minutes through exhaust grilles located not more than 6 inches above the floor level and make up air vents located high on the opposite wall. The ventilated air must be exhausted to the outdoors and not into interior areas. All doors must be hinged to open outward and at least one door will have a viewport to let operators look into the room before entering. Written operating instructions developed by the local safety officer, must be posted near the chlorination facility. Operating switches for lights and ventilation fan must be located exterior to and adjacent to the chlorine room access door.

D-3. A warning sign, similar to the following, must be affixed in a readily visible location at or near entrances to the chlorination room:

CAUTION
CHLORINE HAZARD AREA
UNAUTHORIZED PERSONS KEEP OUT
CAUSES BURNS, SEVERE EYE HAZARD
MAY BE FATAL IF INHALED
IN CASE OF EMERGENCY CALL
(Fire Department #)
DO NOT ENTER SPACE

D-4. Where chlorine gas is used, one of the most important items of safety equipment is a fail-safe type chlorine leak detector. The leak detector must sound an alarm at an atmosphere chlorine concentration of 1 ppm ($3 mg/m^3$). The chlorine detector will be calibrated and maintained per the manufacturer’s instructions. Written records of calibration and maintenance will be kept on file.

D-5. Personal Protection Equipment.

1. Employees will be provided with and required to use impervious clothing, gloves, face shields (eight inch minimum), and other protective clothing necessary to prevent any possibility of skin contact with liquid chlorine.
2. Where there is any possibility of exposure of an employee’s body to liquid chlorine, facilities for quick drenching of the body will be provided within the immediate work area for emergency use.
3. Non-impervious clothing which becomes contaminated with chlorine will be removed immediately and not reworn until the chlorine is removed from the clothing.
4. Employees will be provided with and required to use splash-proof safety goggles where there is any possibility of liquid chlorine contacting the eyes.
5. Where there is any possibility that employees’ eyes may be exposed to liquid chlorine, an eye wash fountain will be provided within the immediate work area for emergency use.

D-6. In the event of a chlorine leak or spill employees must immediately evacuate the area and notify the fire department or rescue unit. Fire department and rescue personnel will be qualified to contain chlorine leaks or spills and are under a respiratory protection program which includes regular training in respirator selection, maintenance, inspection, cleaning, and evaluation.

D-7. Leak repairs must be made by personnel trained in the use of and equipped with a self-contained breathing apparatus (SCBA). It is recommended that SCBA equipment (two sets) be kept at a central location (i.e., fire station) so that they can be used throughout the installation whenever the need arises. SCBA equipment must be maintained per the respirator program. See OPNAVINST 5100.23 series.

D-8. The base safety officer or a qualified dustrial hygienist (located at Naval hospitals, clinics commands and NAVE NPVNTMEDUS) will be consulted about the safe operation of chlorimation facilities.

APPENDIX E
NAVY ENVIRONMENTAL AND PREVENTIVE MEDICINE UNITS

UNIT	GEOGRAPHICAL AREA OF ASSIGNMENT
Navy Environmental and Preventive Medicine Unit No. 2 Norfolk, Virginia 23511-6288 Commercial: (804) 444-7671 AUTOVON:564-7671	20° W longitude West to 100° W longitude, including Iceland
Navy Environmental and Preventive Medicine Unit No. 5 Naval Station, Box 143 San Diego, California 92136-5143 Commercial: (619) 556-7070 AUTOVON: 526-7070	100° W longitude West to 150° W longitude, including all of Alaska
Navy Environmental and Preventive Medicine Unit No. 6 Pearl Harbor, Hawaii 96860-5040 (Mail address: Box 112, Fleet Post Office San Francisco 96610 Commercial: (808) 471-9505 AUTOVON: 430-0111 ask for 471-9505	150º W longitude West to 70° E longitude, except Alaska
U.S. Navy Environmental and Preventive Medicine Unit No. 7 Naples, Italy (Mail address Fleet Post Office New York 09521 Commercial: 9-011-39-81-724-4468/4469 AUTOVON: 450-3219	70° E longitude West to 20° W longitude, except Iceland

APPENDIX F
TREATED WATER QUALITY
STANDARDS

Section 1. NATIONAL PRIMARY DRINKING WATER REGULATIONS
(NPDWR)

F-1. Contaminant Levels for Inorganic Chemicals

Contaminant	MCLG mg/L[1]	MCL mg/L	AL mg/L[2]
Asbestos	7 million fibers/L longer than 10 micrometers	7 million fibers/L longer than 10 micrometers	
Arsenic		0.05	
Barium	2	2	
Cadmium	0.005	0.005	
Chromium	0.1	0.1	
Copper	1.3		1.3[3]
Lead	o		0.015[4]
Mercury	0.002	0.002	
Nitrate (as N)	10	10	
Nitrite (as N)	1	1 '	
Total Nitrate and Nitrite (as N)	10	10	
Selenium	0.05	0.05	
Fluoride	4	4	

1 Maximum Contaminant Level Goal (MCLG). The maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate margin of safety. Maximum contaminant level goals are nonenforceable health goals.

2 Action Level (AL). Concentration of lead or copper in water that determine, in some cases, whether a water system must install corrosion control treatment, monitor source water, replace lead service lines, and undertake a public education program.

3 The copper action level is exceeded if the concentration of copper in more than 10 percent of tap water samples properly collected during any monitoring period is greater than 1.3 mg/L (i.e., if the "90th percentile" copper level is greater than 1.3 mg/L).

4 The lead action level is exceeded if the concentration of lead in more than 10 percent of tap water samples properly collected during any monitoring period is greater than 0.015 mg/L (i.e., if the "90th percentile" lead level is greater than 0.015 mg/L).

F-4. Turbidity. The MCL for turbidity is applicable to both community water systems and noncommunity water systems using surface water sources in whole or in part. The MCL for turbidity in drinking water measured at a representative entry point(s) to the distribution system is:

1. One turbidity unit for monthly average (5 turbidity units monthly may apply at State option).

2. Five turbidity units (maximum) average for two consecutive days.

3. The requirements in this section apply to unfiltered systems until 30 December 1991, unless the State has determined prior to that date, in writing, that filtration is required. These requirements apply to filtered systems until 29 June 1993. The requirements apply to unfiltered systems that the State has determined, in writing, must install filtration until 29 June 1993 or until filtration is installed whichever is later. After the above dates, consult the latest edition of 40 CFR 141.

F-5. Coliform Bacteria

1. The MCL for coliform bacteria (also called total coliforms) is based on the presence or absence of coliforms in a sample rather than on an estimate of coliform density.

a. The MCL for systems analyzing at least 40 samples each month is: No more than 5 percent of the monthly samples may be total coliform positive.

b. The MCL for systems analyzing fewer than 40 samples/month is: No more than 1 sample per month may be total coliform positive.

2. A public water system must demonstrate compliance with the MCL for total coliforms each month it is required to monitor.

3. MCL violations must be reported to the State no later than the end of the next business day after the system learns of the violation.

4. Monitoring Requirements for Total Coliforms:

a. Each public water system must sample according to a written sample siting plan. Plans are subject to State review and revision. The State must establish a process which ensures the adequacy of the sample siting plan for each system.

b. A system must collect a set of repeat samples for each total coliform-positive routine sample and have it analyzed for total coliforms. At least one repeat sample must be from the same tap as the original total Coliform-positive sample; other repeat samples must be collected from within five service connections of the original total coliform-positive sample. At least one must be upstream and another downstream. The system must collect all repeat samples within 24 hours of being notified of the original result, except where the State waives this requirement on a case-by-case basis. If a total coliform-positive sample is at the end of the distribution system, or one service connection away from the end of the distribution system, the State may waive the requirement to collect at least one repeat sample upstream of the original sampling site.

c. If total coliforms are detected in any repeat sample, the system must collect another set of repeat samples, as before, unless the MCL has been violated and the system has notified the State (in which case the State may reduce or eliminate the requirement to take the remaining samples).

d. If a system has only one service connection, the State has the discretion to allow the system to collect the required set of samples at the same tap over a four-day period or to collect a larger volume repeat sample(s) (e.g., a single 400ml sample).

e. If a system which collects fewer than five samples/month detects total coliforms in any routine or repeat sample (and the sample is not invalidated by the State), it must collect a set of five routine samples the next month the system provides water to the public, except that the State may waive this requirement if (1) it performs a site visit to evaluate the contamination problem, or *(2)* it has determined why the sample was total coliform-positive and (a) this finding is documented in writing along with what action the system has taken or will take to correct this problem before the end of the next month the system serves water to the public, (b) this document is signed by the supervisor of the State official who makes the findings, (c) the documentation is made available to EPA and the public and (d) in certain cases (described in this rule), the system collects at least one additional sample.

f. Unfiltered surface water systems and systems using unfiltered ground water under the direct influence of surface water must analyze one coliform sample each day the turbidity of the source exceeds one NTU (this sample counts toward the system's minimum monitoring requirements) .

g. Monthly monitoring requirements are based on population served. Tables 5-F1 and 5-F2 summarize the routine and repeat sampling requirements for total coliforms.

TABLE 5-F1
Total Coliform Sampling Requirements According to Population Served

Population Served			Minimum Number of Routine Samples per Month
25	to	1,000	1 *
1,001	to	2,500	2
2,501	to	3,300	3
3,301	to	4,100	4
4,101	to	4,900	5
4,901	to	5,800	6
5,801	to	6,700	7
6,701	to	7,600	8
7,601	to	8,500	9
8,501	to	12,900	10
12,901	to	17,200	15
17,201	to	21,500	20
21,501	to	25,000	24
25,001	to	33,000	30
33,001	to	41,000	40
41,001	to	50,000	50 **

*** For non-community water systems see NPDWR.**
**** For community water systems serving greater than 50,000 see NPDWR.**

5. Invalidation of Total Coliform Positive Samples

a. Each total coliform-positive sample counts in compliance calculations, unless

b. a turbid culture in the absence of an acid reaction using the P-A;

c. or confluent growth or colony number that is "too numerous to count" using the MF, the sample is invalid (unless total coliforms are determined, in which case, the sample is valid) and the system must, within 24 hours of being notified of the results, collect another sample from the same location as the original sample and have it analyzed for total coliforms. In such case, EPA recommends using media less prone to interference from heterotrophic bacteria for analyzing the replacement sample. The State may waive the 24-hour time limit on a case-by-case basis.

10. Analytical Methodology

a. Total coliform analyses are to be conducted using the 10 tube MTF, the MF, The P-A or the MMO-MUG test. A system may also use the 5 tube MTF technique (using 20 ml sample portions) of a single culture bottle containing the MTF medium, as long as a 100 ml sample is used in the analysis.

b. A 100 ml standard sample volume must be used in analyzing for total coliforms, regardless of the analytical , method used.

c. Fecal coliform analysis must be conducted using methods described in 40 CFR 141.21 and *Standard Methods.*

d. *E. coli* analysis must be conducted using methods described in the *Federal Register* of 8 Jan 91 (56 FR 642) and/or *Standard Methods.*

F-6. The MCL for radiological contaminants are: *

Gross alpha particle activity including radium 226 but excluding radon and uranium. . . .	15 pCi/L
Combined radium-226 and radium-228	5 pCi/L
Tritium.	20,000 pCi/L
Strontium-90	8 pCi/L

*Screening indicators have been established for radiological contaminants. Gross alpha present at less than or equal to 5 pCi/L, as an indicator, eliminates the need to analyze for radium 226 and 228. Gross beta present at less than or equal to 8 pCi./L, as an indicator, eliminates the need to analyze for tritium and strontium-90.

F-7. Sodium and Corrosivity

No MCLs have been published; however, monitoring is required. See Appendix G.

Section II. NATIONAL SECONDARY DRINKING WATER REGULATIONS (NSDWR)

F-8. The secondary MCLs are as follows:

Contaminant	Level
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 color units
Copper	1.0 mg/L
Corrosivity	Non-corrosive
Fluoride	2.0 mg/L
Foaming agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5 to 8.5
Silver	0.1 mg/L
Sulfate	250 mg/L
Total Dissolved Solids (TDS)	500 mg/L
Zinc	5 mg/L

Note: The contaminants covered by this regulation are those that may adversely affect the aesthetic quality of the drinking water. These secondary levels represent reasonable goals for drinking water quality, but are not federally enforceable. The individual States may establish higher, lower or no levels for these contaminants. All Navy and Marine Corps facilities must provide drinking water of the highest quality in consonance with the NSDWR as well as the federally enforceable NPDWR.

APPENDIX G
NPDWR SURVEILLANCE REQUIREMENTS

System	Source	Test	Sampling interval
Community water	Surface water	Inorgmics	annually
		Organics	every 3 years
		Radiochemicals	every 4 years
		Turbidity	daily
		Coliform bacteria	monthly*
		Trihalomethanes	quarterly**
		Nitrates	annually
		Sodium	annually
		Corrosivity	biannually
	Ground water	Inorganic	every 3 years
		Organics	State option
		Radiochemicals	every 4 years
		Turbidity	State option
		Coliform bacteria	monthly*
		Trihalomethanes	quarterly**
		Nitrates	every 3 years
		Sodium	every 3 years
		Corrosivity	annually
Noncommunity water	Surface water	Inorganic	State option
		Organics	State option
		Radiochemicals	State option
		Turbidity	daily
		Coliform bacteria	quarterly
		Nitrates	State option
	Ground water	Inorganic	State option
		Organics	State option
		Radiochemicals	State option
		Turbidity	State option
		Coliform bacteria	one per quarter
		Nitrates	State option

*Number of samples dependent on number of people served bysystem.
**For systems serving greater than 10,000 population. For those systems serving populations less than 10,000 monitoring is at state discretion.

APPENDIX G
NPDWR SURVEILLANCE REQUIREMENTS

System	Source	Test	Sampling interval
Community water	Surface water	Inorgmics	annually
		Organics	every 3 years
		Radiochemicals	every 4 years
		Turbidity	daily
		Coliform bacteria	monthly*
		Trihalomethanes	quarterly**
		Nitrates	annually
		Sodium	annually
		Corrosivity	biannually
	Ground water	Inorganic	every 3 years
		Organics	State option
		Radiochemicals	every 4 years
		Turbidity	State option
		Coliform bacteria	monthly*
		Trihalomethanes	quarterly**
		Nitrates	every 3 years
		Sodium	every 3 years
		Corrosivity	annually
Noncommunity water	Surface water	Inorganic	State option
		Organics	State option
		Radiochemicals	State option
		Turbidity	daily
		Coliform bacteria	quarterly
		Nitrates	State option
	Ground water	Inorganic	State option
		Organics	State option
		Radiochemicals	State option
		Turbidity	State option
		Coliform bacteria	one per quarter
		Nitrates	State option

*Number of samples dependent on number of people served bysystem.
**For systems serving greater than 10,000 population. For those systems serving populations less than 10,000 monitoring is at state discretion.

APPENDIX H
REFERENCES

H-1. **NAVY Instructions**

1. OPNAVINST 5090.1, Environmental and Natural Resources Protection Manual.

2. OPNAVINST 5100.23 Series, Navy Occupational Safety and Health (NAVOSH) Program.

3. NAVFACINST 11330.11. Backflow rreventers, Reduced Pressure Principle Type.

4. NAVSUPINST 5100.24 Series, Calcium Hypochlorite.

5. NAVMEDCOM 6240.1 Series, Standards for Potable Water.

H-2. **NAVAL FACILITIES ENGINEERING COMMAND MANUALS**

1. NAVFAC DM-5.7, Water Supply Systems.

2. NAVFAC MO-210, Operation and Maintenance of Water Supply Systems.

H-3. **NAVAL ENERGY AND ENVIRON-**

MENTAL SUPPORT ACTIVITY

1. NEESA 1-038 Water Management Contingency Planning.

H-4. **NAVAL SEA SYSTEMS COMMAND MANUAL**

1. NAVSEA S6470-AA-SAF-010, Gas Free Engineering.

H-5. DEPARTMENT OF THE ARMY PUBLICATIONS

1. TB MED 576, Sanitary Control and Surveillance of Water Supplies at Fixed Installations.

2. TM5-700, Field Water Supply.

H-6. **PUBLIC LAW** Public Law 93-523, Safe Drinking Water Act.

H-7. **CODE OF FEDERAL REGULATIONS**

1. Title 29, Code of Federal Regulations (CFR), Part 1910 OSHA Safety and Health Standards.

2. Title 40, Code of Federal Regulations (CFR), Part 141, National Primary Drinking Water Regulations, as amended.

3. Title 40, Code of Federal Regulations (CFR), Part 143, National Secondary Drinking Water Regulations.

H-8. **MISCELLANEOUS**

1. U.S. Environmental Protection Agency, Water Supply Division. *Cross-Connection Control Manual,* EPA-570/9-89-007.

2. U.S. Environmental Protection Agency, Municipal Environmental Research Laboratory, *Treatment Techniques for Controlling Trihalomethanes* in *Drinking Water,* EPA-600/2-81-156.

3. American Water Works Association, *Emergency Planning for Water Utility Management,* AWWA manual M19.

4. American Water Works Association, *Standardfor Deep Wells* AWWA No. A100-66.

5. American Water Works Association, *Standard for Disinfection Water Mains.* AWWA No. C-601-68.

6. American Water Works Association, *Standard for Inspecting and Repairing Steel Water Tanks, Stand Pipes, Reservoirs, and Elevated Tanks, for Water Storage,* AWWA D101-53 (R1979).

7. American National Standards Institute (ANSI) Z117.1-1977, *American Safety Requirements for Working in Tanks and other Confined Spaces.*

8. National Academy of Sciences, *D-inking Water and Health,* Volumes 1 (1977),2 (1980) National Academy of Sciences, 201 Constitution Avenue, Washington, DC.

9. Ehlers, V., and E. Steel, *Municipal and Rural Sanitation,* 6th edition, McGraw-Hill Book Company, Incorporated, 1965.

10. Salvato, J.A., *Environmental Engineering and Sanitation,* 3rd edition, John Wiley and Sons, 1982.

11. Freedman, B., *Sanitarian's Handbook, Theory and Administrative Practice for Environmental Health,* 4th edition, Peerless Publishing Company, 1977.

12. White, G. C., *Handbook of Chlorination,* 2nd edition, Van Nostrand Reinhold Company, 1986.

13. APHA-AWWA-WPCF, *Standard Methods for the Examination of Water and Wastewater,* 16th edition, American Public Health Association.

14. U.S. Environmental Protection Agency Manual EPA-430/9-74-007, *The Manual of Individual Water Supply Systems.*

15. U.S. Environmental Protection Agency Manual, EPA-670/9-75-006, *Handbook for Evaluating Water Bacteriological Laborites.*

16. DHHS (NIOSH) Publication No. 81-123, NIOSH-OSHA *Occupational Health Guidelines for Chemical Hazards.*

APPENDIX I
MICROBIOLOGICAL SAMPLING TECHNIQUE FOR DRINKING

Sample Size: For most purposes, a 100 to 120 ml sample will suffice. Prior coordination with the testing agency is recommended.

Type Container: A sterile, clean container with a screw cap will be used in microbiological sampling. EPA approved water sampling bags containing sodium thiosulfate may also be used.

PROCEDURE

I-1. Open the cold water tap and allow the water to flow freely for several minutes to ensure drawing water directly from the mains. Determine the chlorine residual and pH, and record the value.

Note: Samples must not be collected from faucets with aerators, swivel or add-on devices unless these devices are removed before running the water in this step.

I-2. Reduce the flow to produce a small stream of water. Carefully remove the cap or stopper of the sample bottle by grasping the outside of the cap. Do not touch any surfaces which the sample will contact. Hold the cap in the hand. Fill the bottle to within one-half inch of the bottom of the neck and replace the cap.

I-3. Complete, the information required on DD Form 686 (Fluoride Bacteriological Examination of Water) identifying the sample as to exact source, time of collection, chlorine residual, special circumstances if any, and the address to which the report will be forwarded. Identify the sample bottle and the data card by the same number.

I-4. Sodium thiosulfate should be added to the sample container before collection of the sample. This chemical stops the bactericidal action of the chlorine residual present in the drinking water sample. Consult the current edition of *Standard Methods for the Examination of Water* and *Wastewater* for preparation of this chemical. DO NOT RINSE OR FLUSH THE SAMPLES CONTAINER PRIOR TO COLLECTING THE SAMPLES AS THE SODIUM THIOSULFATE WILL BE WASHED OUT!

I-5. In the case of individual potable water samples sent to the laboratory by courier, the elapsed time between collection and examination will not exceed 6 hours. (The exception to this 6-hour rule is for samples mailed from distant installations; these samples may be held for up to 30 hours.) Samples will be refrigerated to 4° C during shipment. The time and temperature of storage of all samples will be recorded and must be considered in the interpretation of data.

I-6. Flaming water taps before collecting potable water samples is not necessary if reasonable care is exercised in the choice of sampling tap (clean, free of attachments, and in good repair) and if the water is allowed to flow at a uniform rate before sampling. Alterations in the valve setting to change the flow rate during collection could affect the sample quality. Superficially passing a flame from a match or an alcohol-soaked cotton applicator over the tap a few times may have a psychological effect on observers, but it will not have a lethal effect on attached bacteria. The application of intense heat may damage the valve-washer seating or create a fire hazard to combustible materials next to the tap. If successive samples from the same tap continue to show coliforms, the tap maybe disinfected with a hypochlorite solution to reduce external contamination as the source of these organisms.

APPENDIX J
REMEDIAL ACTIONS TO BE TAKEN IN EVENT CONTAMINATED WATER SAMPLES ARE FOUND

Conditions	Possible Cause	Recommendations
1. No known sanitary defects, health hazards, or incidents of a gastrointestinal disease.	The contaminated samples might indicate a localised situation within the piping of the building where the sample was collected, or a faulty sampling technique.	a. Collect repeat samples promptly. b. Expedite shipment of samples so that a prompt report may be obtained from the laboratory. c. Make an immediate investigation to determine if any unusual conditions have occurred, such as repairs to the water mains, faucets, or piping within the building, or in the vicinity of the sampling point. d. Test for chlorine at various outlets to ensure the proper dosage. e. If the foregoing investigation shows the need, flush the portion of the system by opening outlets, until a proper chlorine residual is recorded; carry out localised chlorination if needed. f. Resample following paragraph 5-20.3.e. g. If examination shows that conditions defined in paragraph 2 below exist, then the remedial actions recommended in that paragraph must be followed.
2. occurrence of a major disaster, such as the inundation of the source, breakdown in treatment plant units, gross contamination of the system through a cress-connection, failure of an underwater crossing, damage from an earthquake, etc.	Self evident.	a. Immediate rejection of water supply system and institution of an emergency treatment program. Treat all drinking water and water used for culinary purposes. b. After the necessary repairs have been completed, super-chlorinate and flush the entire system. c. Collect samples from representative points throughout the system until negative microbiological results are obtained on at least two consecutive sets of standard samples collected on different days. d. Remove restrictions on the use of water.
3. Occurrence of an outbreak of one of the so-called waterborne diseases.	Contamination of the water system at the source, in reservoirs, treatment plant facilities, or distribution system and not generally obvious at the onset of the outbreak.	a. Carry out recommendations under Condition 1 with special emphasis on the investigation of the source, reservoirs, treatment processes, and distribution system. b. Increase the chlorine dosage and residual in the system. c If the conditions contributing to the contamination are found to be serious, such as a direct contamination with sewage, reject the supply and institute emergency treatment until the condition is corrected.

Bureau of
Medicine and Surgery
Washington, DC 20372-5300

NAVMED P-5010-6 (Rev. 7-2005)
0510-LP-103-9057

Manual of Naval Preventive Medicine

Chapter 6

WATER SUPPLY AFLOAT

DISTRIBUTION STATEMENT "A"

This publication supersedes NAVMED P-5010-6 of 1990 S/N 0510-LP-206-6300

NAVMED P-5010-6

Chapter 6
Manual of Naval Preventive Medicine
Water Supply Afloat

25 Jul 2005

To: Holders of the Manual of Naval Preventive Medicine

1. **Purpose.** This revision reflects information for safe and proper potable water handling procedures for United States Naval Ships (USNS).

2. **Action.** Replace entire chapter 6 with this version.

D. C. ARTHUR
Chief, Bureau of
Medicine and Surgery

CHAPTER 6
WATER SUPPLY AFLOAT

CONTENTS

CONTENTS
(Continued)

CHAPTER 6
WATER SUPPLY AFLOAT

TABLES **Page**

LIST OF APPENDICES

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION I. INTRODUCTION

6-1. Scope

a. This chapter provides information for safe and proper potable water handling procedures for United States Naval Ships (USNS). Applicable potable water quality standards are set forth in current Office of the Chief of Naval Operations (OPNAV), Bureau of Medicine and Surgery (BUMED), and Military Sealift Command (MSC) instructions. The basic principles outlined in the following sections will help prevent water-borne disease outbreaks. The use of trademark names in this publication does not imply endorsement by the Department of Navy (DON), but is intended only to assist in identifying specific products.

b. All personnel concerned with loading, treatment, storage, distribution, and medical surveillance of potable water should be familiar with current applicable naval instructions and directives, which supplement this chapter.

6-2. Responsibilities

a. The Naval Sea Systems Command (NAVSEASYSCOM) is responsible for the design, construction, and maintenance of the shipboard potable water systems, including treatment facilities and processes to assure that safe drinking water is available at all times.

b. The Naval Facilities Engineering Command (NAVFACENGCOM) is responsible for promulgating instructions for ship-to-shore potable water connections and for providing potable water from an approved source when the ship is berthed at a naval facility.

c. Chief, BUMED is responsible for establishing and promulgating health standards for water quality afloat. BUMED will promulgate appropriate instructions, notices, or other publications to reflect afloat water quality requirements. Additionally, BUMED will set forth shipboard requirements for medical surveillance of potable water systems.

d. Area, fleet, and subordinate commanders are responsible for issuing the necessary implementing directives to ensure that adequate water sanitation standards are provided and enforced in each ship within the command.

e. The commanding officer, master, or other applicable responsible party of each ship is responsible for promulgating a water sanitation bill to ensure that procedures for receipt, transfer, treatment, storage, distribution, and surveillance are provided and followed.

f. The engineering department of the ship is responsible to the commanding officer or master for implementing the requirements of the NAVSEASYSCOM. This responsibility includes the supply and treatment of potable water and for the system components that receive, store, distribute, produce, and treat potable water. The engineering officer shall ensure that all ship-to-shore connections are made only by authorized shore personnel, when available, or in their absence, ship personnel who are properly supervised by authorized shore personnel; and that all connections required for ship-to-ship potable water transfer are made by personnel trained in handling potable water.

The engineering officer is responsible for the chloride and hydrogen ion (pH) testing of the ship's potable water. The engineering department shall ensure minimum halogen residuals are maintained at a potable water tank before placing the tank on-line to the potable water distribution system.

g. The medical department representative (MDR) is responsible for conducting a medical surveillance program of the potable water system including collection of samples for coliform bacteria testing as prescribed and daily halogen residuals from the distribution system. The MDR shall notify the commanding officer or master of any discrepancies observed in the potable water distribution system.

6-3. Shipboard Potable Water

a. Shipboard potable water primarily comes from approved ashore sources and ships water production plants which include distillation plants or reverse osmosis (RO) plants. Present water plants aboard naval ships are designed to make the ship as self-sufficient as possible. Generally, ship water treatment plants are capable of producing potable water from bacteriologically contaminated seawater, provided the specific procedures set forth in Chapters 531 and 533 of the Naval Ships Technical Manual (NSTM) are followed. In addition, potable water must be adequately disinfected to maintain the required halogen residual level in the potable water tanks and distribution system.

b. Avoid making water while operating in harbors or from polluted seawater. Seawater shall be assumed polluted when ships are operated in close formation. While making potable water, care must be taken not to strip fuel waste tanks or empty bilges forward of the saltwater intakes. Source water in harbors or ship navigation lanes is likely to be contaminated by fuel/oil slicks or other pollutant sources. Volatile Organic Chemicals (VOCs), which have a lower boiling point than water and which could be present in contaminated unapproved source waters, can vaporize and mix with the water vapor during the distillation process, carrying over into the condensate chamber and distillate reservoir.

c. Distilled water tends to be mineral free and can be highly corrosive to metal piping and storage tanks. The leaching of lead and copper from plumbing fixtures and service lines and any other sources in contact with potable water (lead-based paint) is of special concern. Operational checks of shipboard water plants afloat, inspection, and approval of watering points ashore are only a part of the precautions necessary to assure a safe water supply. Many points of possible contamination exist within the ship and may contribute to waterborne disease outbreaks. Therefore, regardless of the source of the water, there must be vigilant surveillance to assure adequate protection from subsequent contamination.

d. Potable Water Sources for Naval Ships:

(1) Distillation, RO, or other NAVSEA approved water production technology.

(2) Shore-to-ship delivery from an approved source.

(3) Shore-to-ship delivery from an unapproved source (when approved source does not exist), refer to Article 6-7.

(4) Ship-to-ship.

e. Potable water is used aboard ship for drinking, cooking, laundry, medical, personal hygiene, and other purposes.

f. Health concerns regarding potable water quality may include physical, chemical, and bacteriological parameters. Direct chemical additives to potable water systems afloat should be tested/certified by the product manufacturer in accordance with National Sanitation Foundation International Standard known as NSF/ANSI Standard 60: *Drinking Water Treatment Chemicals – Health Effects*.

Likewise, indirect chemical additives to potable water systems afloat should be tested/certified by the product manufacturer in accordance with NSF/ANSI Standard 61: *Drinking Water System Components – Health Effects*. Manufacturers should meet other applicable NSF/ANSI potable water public health standards as indicated.

g. Use of seawater in food services spaces including sculleries is prohibited and seawater outlets in these spaces must be removed. The dangers of cross connections and of using polluted overboard water cannot be overemphasized. Cross connections between the potable water and seawater of other systems are not permitted. ***Exception****:* specific garbage grinders, which use seawater flush and have been approved by BUMED for use in designated sculleries. Installation of salt water flush garbage grinders precludes storage of clean dishware or other items in the scullery because of concerns for aerosol contamination.

h. Seawater is used aboard ships such as in the fire mains, decontamination, and for marine sanitation devices (MSDs) flushing. Since conservation of potable water is a constant requirement, it is impractical to provide potable water for all purposes.

6-4. Potable Water Usage Requirement

a. Proper indoctrination of the crew and attention to leaks and waste should limit potable water consumption to reasonable amounts. Water hours may at times become necessary on some ships and this may adversely impact personal hygiene practices. This is particularly applicable to troop-carrying ships loaded beyond their water-producing capacity. Personnel may keep clean and live under sanitary conditions, even with a limited water supply. If unusual conditions require drastic restrictions in the use of potable water, the allowances should not be less than 2 gallons per man per day to be used for drinking and cooking purposes. In hot environments it is necessary to provide sufficient drinking water quantity to prevent heat casualties.

b. For new ship constructions, 50 gallons per day per man is specified by NAVSEA for design considerations. This encompasses a broad spectrum of potable water uses including drinking water, galley and scullery, personal hygiene, and laundry.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION II. RECEIPT AND TRANSFER

6-5. Receipt and Transfer of Potable Water

a. When receiving or transferring potable water via approved sources, proper procedures must be followed to prevent contamination.

(1) A free available chlorine (FAC), chloramines (total chlorine), or total bromine residual as applicable shall be completed prior to the initial transfer of water.

(2) If water taken aboard the ship does not have the required halogen residual, the ship must boost halogen residual, or have shore facility boost halogen residual in source water to obtain the proper residual.

(3) When potable water from the transferring source contains the proper halogen residual, no further treatment is required.

b. Potable water connections between shore and ships must be made or supervised by authorized shore station personnel. In the event shore personnel are unavailable, properly trained ship personnel will complete this responsibility. The individual making the potable water hose connections shall ensure hoses are not connected to a non-potable system. Engineering will notify the MDR prior to making potable water hose connections. The MDR shall determine if the correct halogen residual is present in the source water and if it is not, he or she must notify the engineering department representative.

c. Potable water hoses shall not be submerged in harbor water.

6-6. Approved Sources. Potable water may be received from approved shore facilities or other vessels. The following are approved potable water sources:

a. Environmental Protection Agency (EPA) (State and territory) approved public water systems.

b. Approved U.S. military sources including establishments under the cognizance of the British Royal Navy, Canadian Forces, and the Royal Australian Navy. These sources are subject to termination or modification. See the current American-British-Canadian-Australian Naval Quadripartite Standardization Agreement Program, ABCA NAVSTAG 23, Quality Standards for Potable Water. Under certain emergency or wartime situations, shore water sources may be under the cognizance of Quadripartite Standardization Agreement 245, Edition 2, of the American-British-Canadian-Australian Armies Standardization Program, Minimum Requirements for Water Potability (Short and Long Term Use) or the NATO Standardization Agreement, STANAG 2136, Minimum Requirements of Water Potability for Short Term Issue.

c. OCONUS water source information may be obtained from U.S. military representatives ashore or Navy Environmental Preventive Medicine Units (NAVENPVNTMEDUs) having area responsibility.

d. Bottled water must be obtained from DOD approved sources.

6-7. Sources of Doubtful Quality. All water supplied by public or private systems not listed in Article 6-6 should be considered of doubtful quality. When doubt exists as to the quality of water, the MDR, or a responsible officer must investigate the source and examine the water as thoroughly as possible with the means available; he or she must then advise the commanding officer or master relative to necessary procedures, safeguards, and disinfection. In instances where the ship must receive water of doubtful quality, disinfection will be accomplished in accordance with Article 6-21.

6-8. Care of Shipboard Potable Water Hoses and Equipment

a. Potable water hoses shall not be used for any other purpose. They must be properly labeled, stored, and protected from sources of contamination at all times. They must be examined routinely and removed from use when cracks develop in the lining or leaks occur. Disinfection procedures for potable water hoses are found in Articles 6-9 and 6-23.

b. Shipboard potable water risers shall be at least 18 inches above the deck and turned down, except when risers are located within the ship, such as in submarines. Potable water riser must be properly labeled and fitted with a cap and keeper chain. Potable water riser valve or valve handles must be properly color coded in accordance with NSTM Chapter 505. Riser hose connections shall be disinfected prior to connection.

c. Potable water tank sounding tubes will be equipped with screw caps attached to keeper chains. Screw caps will be secured with a lock. On those ships with sounding rods, the rod should remain in the tube at all times. Potable water sounding tapes must be sanitized prior to each use and shall only be used for potable water tank volume measurements.

6-9. Connection Procedures. Table 6-1 provides guidelines for connection procedures covering ship-to-shore and ship-to-ship transfer of potable water. Modification of these procedures may be necessary or required due to ship configuration or operating conditions.

Table 6-1. Potable Water Transfer Procedures for Ship-to-Shore and Ship-to-Ship*

Ship-to-Shore	Ship-to-Ship
Remove shore cap and flush pier side potable water outlet for 15-30 seconds. Immerse outlet and rinse fitting in solution containing 100-ppm FAC (free available chlorine) for at least 2 minutes. Flush water to waste for 15-30 seconds.	Both ships disinfect their respective potable water riser connections. The leading potable water hose shall have the hose cap in place during the high-line procedure.
Deliver a clean disinfected potable water hose to the outlet just before the connection is made (potable water hoses should be provided by the shore facility). Remove hose caps or uncouple hose ends and disinfect if not previously disinfected. Connect hose to pier side outlet and flush.	When the receiving ship secures the potable water hose, the cap is removed and the hose coupling is disinfected.
Disinfect shipboard riser connections with 100-ppm FAC solution. Connect hose to the potable water shipboard riser and deliver potable water. Other FDA listed food contact surface disinfectants such as iodine may be used if approved by the MDR.	The supplying ship connects its end and flushes the hose.
When the transfer is completed, secure the shore water source; remove the ship connection, then the shore connection. Thoroughly flush the potable water outlet and recap.	When the transfer is completed, the receiving ship removes the potable water hose and replaces the caps on the receiving connection and the potable water hose.
Drain the potable water hose thoroughly and properly store in the potable water hose storage locker.	The supplying ship then retrieves, couples or caps, and properly stores the potable water hose.

*Tables read top to bottom, not left to right.

SECTION III. STORAGE AND DISTRIBUTION

6-10. Potable Water Production

a. **Types of Water Production Plants**

(1) **Distillation plants.** Installed on naval vessels are three general types, depending on the source of heat used to evaporate seawater.

(a) Steam distilling plants are operated by steam supplied directly or indirectly from a power plant or auxiliary boiler. They are subdivided into two groups, submerged type and flash type. These subdivisions differ mainly in the pressure in the heating elements and evaporator shell.

(b) Waste heat distilling plants are submerged tube type and use heat derived from diesel engine jacket water.

(c) Vapor compression type distilling plants require primarily only electrical energy for operations; however, additional heat exchangers that use waste heat (exhaust gas or cooling water) may be installed.

(2) **Reverse osmosis (RO).** Single and triple pass RO plants are another type of shipboard water production technology. RO consists of a pre-filtration section that typically includes, in surface ships, a coarse strainer, a centrifugal separator and cartridge filters that remove suspended particles as small as 1 micron in some cases. Triple pass RO plants used for submarines do not have a separator but are fitted with cartridge filters nominally rated at 3 micron to remove suspended particles. The RO water treatment technology in lieu of distillation will likely be the technology of choice for fresh water production for new construction ships. A brief discussion of RO treatment is below.

(a) Through a high-pressure pump, the filtered water is then boosted up in pressure to as much as 1000 psi where it is introduced into the RO pressure vessels that contain circularly wrapped polyamide thin film RO membranes. A portion of the filtered water, typically 20-25 percent, permeates through the membrane to become fresh water. The remaining brine, which does not pass through the RO membrane, is discharged from the RO unit as waste.

(b) Although the RO membrane is theoretically capable of removing all viruses and bacteria from the source water under optimal operating conditions, membrane fouling does occur and can compromise the integrity of the membranes. Reverse osmosis is not solely relied upon for accomplishing pathogen removal in single pass RO plants thus additional disinfection such as chlorination or bromination is required.

(c) In triple pass RO plants additional disinfection requirement is waived because it is assumed that the redundancy of three membranes, connected in series, would accomplish adequate removal of pathogenic organisms. Triple pass RO water quality is comparable to distilled water and often may be better.

b. NSTM Chapter 533, Potable Water Systems (1995), and NSTM Chapter 531, Desalination, Volume 3 Reverse Osmosis Desalination Plants (1999), RO treated water from a single pass RO unit ranges in purity from 350 to 500 ppm Total Dissolved Solids (TDS), while distilled water purity is on the order of 1 to 2 ppm TDS and a third pass RO unit can produce water with less than 1.0 ppm TDS. Low TDS distilled water and multi pass RO water can be more corrosive to plumbing and storage tanks than single pass RO water. In addition, water high in dissolved gasses (e.g., carbon dioxide and oxygen), after multiple passes through RO membranes, can also be corrosive.

c. Although potable water production/ treatment is an engineering responsibility, the MDR must be cognizant of the process to adequately provide surveillance and recommendations.

6-11. Potable Water Tanks

a. The construction and location of potable water tanks should prevent contamination of the water. For full utilization of space, potable water is stored on most ships in inner bottom tanks, other skin tanks, and peak tanks. The ship bottom, which serves as the outer shell of the inner bottom tanks, is subjected to maximum external pressure from water that may be heavily polluted, and is vulnerable to leakage. The plating over the inner bottom tanks often serves as the deck in machinery spaces. Inner bottom and other skin tanks may have common bulkheads with ballast tanks, fuel tanks, or other storage spaces. These potential sources of contamination make it necessary to devote careful attention to maintaining the quality of water stored in skin tanks, particularly those located in inner bottoms.

b. Potable water tanks should not be filled with ballast water unless absolutely necessary for the survival of the ship. When non-potable liquid (water) is introduced into potable water tanks, all tanks, lines, fittings, and pumps must be disconnected from the potable water system, plugged or capped, and not reconnected until adequately cleaned, flushed, disinfected, and tested as applicable in accordance with Article 6-22. Cross connections between potable and non-potable water must be prevented for force health protection.

6-12. Vents and/or Overflow Lines. Vents and/or overflow lines provided on potable water tanks will be located to reduce the possibility of contamination. The openings must be screened with 18-mesh or finer non-corrosive metal wire. They must not terminate in food service, medical, toilet, or other spaces where contamination or odors may be transmitted to the water, nor in any space where electrical or electronic equipment is located. In no instance will potable water tanks vent outside the ship.

6-13. Manholes. The construction and location of manholes should minimize the possibility of contamination. If a manhole is located on the side of the tank, flush-type construction is acceptable. If located on the top (including the deck, if the deck forms the top of the tank), a coaming or curb rising at least one-half inch above the top of the tank must be provided and the manhole cover must extend to the outer edge of the curb or flange. The cover must have an intact gasket and a device for securing it in place. Normally, manholes not exposed to the weather decks are fitted with the flush-type manhole cover or the raised, bolted-plate cover. The latter is preferable for potable water tanks.

6-14. Measurement of Water Level

a. There are several methods for measurement of water volume in tanks including automatic level gauges, petcocks, and sounding tubes. Many ships have more than one system. On those ships with sounding rods, when not in actual use, the rod should remain in the sounding tube at all times. On those ships using steel tapes, the tapes must be sanitized prior to each use, stored in a sanitary manner, and used only for potable water measurements in accordance with Article 6-23.

b. Soaking the entire tape apparatus in a solution of 100-ppm FAC (free available chlorine) solution for 2 minutes may be used to sanitize potable water sounding tapes. Another method, which can be used, involves wiping the tape with clean gauze soaked in an approved disinfectant solution such as food service contact surface disinfectant in accordance with Article 6-23, such as iodine (Wescodyne) disinfectant or alcohol swab.

6-15. Filling Lines

a. Potable water lines/piping must never be cross connected to any non-potable piping or system. Where a common line is used to load and distribute potable water to non-potable tanks, the delivery to the non-potable tanks must be through an air gap or approved and appropriate backflow prevention device. Filling lines that have common piping arrangement for directing potable water from an approved source to non-potable water systems by means of valves or interchangeable pipe fittings are not acceptable.

b. Filling connections (hose valves) must be clearly labeled and color-coded in accordance with NSTM Chapter 505. They will be secured with screw caps attached with keeper chains in accordance with Article 6-8.

c. Filling connection hose valves must have the potable water receiving connection at least 18 inches above the deck and turned down to protect it from contamination following Article 6-8.

6-16. Potable Water Piping

a. Special attention must be given to potable water piping located in the bilge area, particularly the piping on the suction side of the potable water pumps where leakage could result in contamination. This piping should be hydrostatically tested in accordance with the preventive maintenance system, and kept in sound material condition.

b. Shipboard design specifications stipulate potable water piping through non-potable tanks and piping non-potable liquid through potable water tanks must have the pipe surrounded by sloped self-draining pipe tunnel.

c. Ensure adequate air gap or approved backflow prevention device is provided between the potable water outlet and a non-potable water system, fixture, or machine. Article 6-42 provides more information on cross connection control.

d. All potable water pumps should be airtight and free from cross connections. Non-potable water should never be used for priming pumps or maintaining packing gland seals. Pumps that have been dismantled for repair must be disinfected after reassembly prior to being returned to service.

e. To avoid scald injuries, the temperature setting for the hot water heaters serving habitability space showers and lavatories must be set not to exceed 120°F at the water tap. Hot water heaters serving other areas such as the galley (Gaylord Hoods), laundry, etc., are set at appropriately higher temperatures.

f. Point of use potable water treatment devices such as charcoal impregnated or other filter equipment use are generally not recommended. Only NSF certified point of use devices shall be used. These devices remove required trace halogen residual from the potable water and defeat the purpose of residual halogen protection. In addition, charcoal filtration devices can promote bacterial growth, especially when not used on a daily basis or when not changed at proper intervals. Point of use water treatment devices shall be used and maintained in accordance with the manufacturer's directions.

6-17. Repairs

a. In the event of a break or compromise in the potable water system, or a potable water tank is entered for any reason, all involved tanks, parts, and lines must be cleaned, flushed, and disinfected prior to returning the system to use. The MDR must be notified of the break or entry and the disinfection procedure accomplished by the engineering department.

b. For potable water piping repairs including flanged joints, only sealants and lubricants certified to NSF/ANSI Standard 61 shall be used. Confirmation concerning authorized sealants and lubricants may be obtained by contacting NAVSEASYSCOM.

6-18. Potable Water Tank Coatings

a. Only potable water tank coatings that are listed within NSTM Chapter 631 and NSF/ANSI Standard 61 are approved for use. Taste and odor problems with water quality are often associated with improper application and curing procedures. Paint thickness, the touch-up material, ventilation, temperature, humidity, curing time, etc., are important application factors that can contribute to taste and odor complaints. Taste and odor are further discussed in Section VIII.

b. The shipyard or contractor may wish to complete potable water taste/odor testing, after construction or repair of potable water tanks. Water taste complaints are not uncommon from ships which have undergone recent potable water tank painting.

6-19. Labeling and Color-Coding

a. Potable water sounding tubes will be clearly labeled with an identification plate. The sounding tube cap will be color-coded dark blue. On ships using steel tapes for sounding potable water tanks, the tape handle must be color-coded dark blue, labeled, or otherwise identified "POTABLE WATER USE ONLY."

b. Valves for receiving or supplying potable water must be conspicuously designated by a warning plate bearing the inscription "POTABLE WATER ONLY" in ¼ inch high letters.

c. Potable water hoses must be labeled "POTABLE WATER ONLY" with 1-inch high letters approximately every 10 feet and the end couplings painted dark blue in accordance with NSTM Chapter 505.

d. Potable water piping passing through any given space must be appropriately labeled to indicate the type of service and with an arrow indicating the direction of the flow.

6-20. Potable Water Hose Storage Lockers. Potable water hose storage lockers must be identified and labeled "POTABLE WATER HOSE." When not in use, potable water hoses must be coupled or capped and stored in designated lockers. The lockers must be vermin proof, locked, and be elevated at least 18 inches off the deck when located on weather decks and sponsons. Printed instructions outlining step-by-step methods for disinfection of potable water hoses and risers must be posted in a conspicuous location inside the hose storage locker in accordance with Article 6-55, Sample Water Sanitation Bill.

SECTION IV. DISINFECTION

6-21. Disinfection of Potable Water Supplies

a. **General**

(1) Disinfection of water is required to ensure the destruction of pathogenic organisms. Maintenance of a halogen residual is the usual method of guarding against contamination or accidents that may occur during the production, handling, storage, and distribution of potable water. The absence of a Free Available Chlorine (FAC) or total bromine residual (TBR) in the ship's potable water may indicate contamination. The presence of a halogen residual provides a safety factor but does not correct unsanitary practices or conditions. FAC residual concentrations as high as 1.0 ppm at the tap usually do not cause objection-able tastes and odors, but where certain organic substances are present, very small concentrations of combined chlorine or bromine can produce undesirable tastes or odors. These undesirable tastes and odors do not affect the safety (potability) of water but may impact palatability (taste) of water, thus discourage water consumption. While the National Primary Drinking Water Standards are not applicable for shipboard potable water systems, EPA has established a maximum contaminant level (MCL) for all disinfectants at 4 ppm.

(2) All water has some halogen demand which is the amount of chlorine or bromine used through reaction with substances present in the water. Shipboard water is disinfected by the addition of sufficient chlorine or bromine to produce not less than 0.2 ppm FAC or TBR after 30 minutes contact time measured at the potable water tank. The amount of chlorine or bromine required to produce a FAC or TBR of not less than 0.2 ppm after 30 minutes can vary widely because of halogen demand, water temperature, and other factors. Again, these chemical reactions may impact water palatability.

(3) **Halogen types.** Chlorine and bromine are approved methods for disinfecting shipboard potable water. Mechanical methods of treatment are preferable to chlorine batch treatment procedures. Batch chlorination procedures are less reliable, require greater time and effort, and are generally less effective. Many municipal water sources use chloramine for disinfection which needs to be considered when doing halogen testing pier side. Chlorine or bromine can be added to chloramine treated municipal water.

(a) **Chlorine**

1. Chlorine is available for shipboard use as calcium hypochlorite (HTH 65-70% available chlorine), 6-ounce bottle, a granular solid or sodium hypochlorite in varying strengths, as a liquid. Common household bleach (unscented) is a 5.25% solution of sodium hypochlorite. HTH is most frequently used because of its relatively long shelf life and reduced storage space requirements. However, it should be noted that HTH presents a potential personnel and fire hazard due to its corrosiveness and chemically active nature. This material is classified as hazardous and requires special storage precautions and shall be handled and stowed in accordance with NSTM, Chapter 670.

Contact between HTH and oxidizable material may result in spontaneous combustion (fire). HTH should be obtained in 6-ounce containers and stored in a cool, dry, well-ventilated place where there is no danger of contact with oxidizable materials. Calcium or sodium hypochlorite will lose strength gradually with age and more rapidly when opened or stored in hot spaces or sunlight.

2. The ready use stock of 6-ounce HTH bottles issued to the engineering department must be stowed in a locked box mounted on a bulkhead, preferably in the department office space. Under no circumstances is the box to be installed in a machinery space, flammable liquids storeroom, paint locker, berthing space, storeroom, or in the oil and water test laboratory areas. A metal box, such as a first aid locker, is recommended for this purpose. Vent holes (such as three 1/4 inch holes) shall be drilled in the bottom of the box to allow release of any chlorine products. No more than a 7-day supply shall be maintained in ready use stock at any time.

3. Storeroom stocks of HTH must be stowed in labeled, ventilated lockers or bins. The lockers or bins must be located in an area where the maximum temperature will not exceed 100°F (37.8°C) under normal operating conditions and is not subject to condensation or water accumulation. The area must not be adjacent to a magazine and the lockers or bins must be located at least 5 feet from any heat source or surface, which may exceed 140°F (60°C). They must not be located in an area used for stowage of paints, oils, grease, or other combustible organic materials. No more than forty-eight 6-ounce bottles shall be stowed in any individual locker or bin. Issue will be made only to personnel designated by the MDR or engineering officer.

4. All lockers, bins, and enclosures containing HTH must be labeled with red letters on a white background, (HAZARDOUS MATERIAL, CALCIUM HYPOCHLORITE).

5. Electrolytic disinfectant generator (EDG) uses brine electrolysis chemical process to produce a sodium hypochlorite solution (FAC) for injection. Chemical additives, including salt shall be certified to NSF/ANSI Standard 60.

(b) **Bromine.** Bromine is provided by a bromine impregnated resin cartridge, which is classified as slightly corrosive and requires proper handling and storage procedures. Bromine cartridges must be stored in a clean, dry, ventilated storeroom. Bromine storage lockers require a hazardous warning plate described, in NSTM Chapter 533, Figure 6. Bromine cartridges have a shelf life of 2 years from the date of manufacture. Cartridges exceeding the shelf life can still be used, but chemical disinfection efficiency may be reduced.

b. **Mechanical Methods of Disinfection**

(1) **Naval vessels use several types of chlorinator installations.** Chlorinators may be installed in the distilling plant, distillate line, and the shore fill line. The chlorinator may also serve both the distillate line and the shore fill line.

(a) The distillate line is generally provided with an electric, motor-driven chlorinator. These chlorinators will have controls, which energize the chlorinator in conjunction with the distillate pump motor and water flow past the chlorinator.

(b) The shore fill line is generally provided with a hydraulically actuated chlorinator or an electrical motor driven chlorinator. The hydraulically actuated unit injects hypochlorite solution into the water system in proportion to the flow of water through a meter.

(c) The distillate line and the fill line may be served by a fill line chlorinator unit if the distilling plant is large enough to permit sufficient flow through the unit. This type of installation is generally provided with a hydraulically actuated or an electric motor-driven chlorinator.

(2) **Bromine treatment installations use two types of brominators.** One type is used on the discharge line and the other is used to recirculate water in the potable water tanks during treatment.

(a) The in-line (proportioning) brominator is used when the desalination unit is online and making water. Multiple vendors manufacture these devices. Dependent on design, the unit is either provided with a set of orifices that gauges a predetermine proportion of flow through a bromine cartridge or via a throttle valve design which controls flow. In line brominator units contain an orifice preset to deliver 0.7 ppm bromine to the water during normal operating procedures and an orifice to deliver 2.0 ppm bromine to the water when an increase in total bromine is required as detailed in Article 6-21a(3)(b). The throttle valve design also allows for adjustment of bromine feed. Bromine is washed from the cartridge into the bypassed water stream. One in-line brominator is required for each water plant.

(b) The recirculation brominator unit is designed to boost bromine residual for water in a potable water tank. Treatment is accomplished by the recirculation of potable water from a potable water tank through the brominator and back to the same tank. This treatment offers diversity in recirculation and bromination of water received from external water sources as well as providing capability to boost bromine levels from ship produced water when necessary. As the water in a selected tank is recirculated, a portion of the recirculated water is automatically proportioned to flow through the bromine cartridge. A timing device to achieve the required bromine feed into the selected tank limits flow through the cartridge. After a pre-calculated period of time, the timing device terminates the bromine feed into the water. Recirculation of water continues for an additional pre-calculated time period to complete an even dispersion of bromine through the tank. These time period calculations are based on individual tank volume and temperature of the water. This recirculation unit is also preset to deliver 0.7 ppm bromine to the water being recirculated. A sampling tap is present to test the bromine residual after recirculation; if the desired level of bromine has not been achieved through the initial recirculation process, the timer may be reset and the water recirculated until the desired level of TBR is achieved; however, efforts to achieve bromine levels at the 2.0 or higher ppm level may not be practical due to the length of time required. It may be more convenient to use batch chlorination procedures to rapidly raise the levels of chlorine in the water supply, particularly in the event of contamination or necessity to achieve higher chlorine levels.

(3) **The batch chlorination method of disinfection may be used if mechanical methods for treatment are not available.** However, this is considered the least desirable method of disinfecting a potable water tank because it may result in over-chlorination due to the inability to properly mix the water and hypochlorite solution. The proper dosage of chemical must be determined for the volume of water to be disinfected. Article 6-25 provides guidance for determining the chlorine dosage. When 65-70% strength HTH is used, the calculated amount is dissolved in a non-glass container of warm water (80°F to 100°F) and the suspended matter is allowed to settle out. Only the clear fluid (supernatant) is introduced into the sounding tube when the tank is about 1/4 full, add 1 gallon of potable water to flush the sounding tube. Under no circumstances should chlorination be attempted by adding the solution to the brominator cartridge container. The remaining sediment is discarded as waste. Sufficient mixing of chlorine and water usually will be obtained by the stirring action of the incoming water as the tank is being filled. The motion of the ship will make a small contribution to mixing, and additional mixing may

be obtained by recirculation. If the chlorine solution must be introduced into a full tank, recirculation through a pump is the only way to achieve adequate mixing. If pumps are used which are not an integral part of the potable water system, they must be disinfected as described in Article 6-22. Thirty minutes or more after the tank is filled or mixing is completed; the water should be sampled and tested for a FAC residual. If there are no sampling petcocks on the tank, a potable water outlet in the distribution system nearest the tank may be used for sampling purposes. If the FAC residual is less than required, additional chlorine must be added and mixed into the water, after the required contact time, the FAC residual must be determined again. A convenient figure to remember is that 1-ounce of full strength HTH added to 5,000 gallons of water is the approximate dose for 1.0 ppm initial chlorine concentration. (Note: The amount of active chlorine in 65-70% HTH is reduced rapidly by exposure to air; therefore, all the contents should be used as soon as possible after opening the container.) This rule of "thumb" (1-ounce per 5,000 gallons) becomes a tool in calculating dosages for “batch chlorination” and is suggested as a starting point only; the required amount will depend on temperature, pH, and the chlorine demand of the water. In no instance should the manhole cover be removed to batch chlorinate a tank. Sounding tubes, air vents, or other methods should be used to introduce the chlorine into the tank.

(4) Chlorination or bromination procedures are not adequate until the required FAC/TBR is obtained after the allotted contact time at the potable water tanks. Required halogen residuals are listed in Article 6-26.

(5) Ships with bromine systems may add bromine to water that has been previously chlorinated without any harmful effect.

c. **Halogen Requirements**

(1) Halogen residual of 0.2 ppm throughout the distribution system should be maintained. However, due to halogen demand and other factors it is recognized that this requirement is sometimes not achievable in certain sections of the ship, such as the highest 0-levels on large platform ships, where constant usage/flow of potable water is reduced. In the absence of bacteriological contaminants, this lack of measurable (trace) residual in the less used outlets should not be a matter of concern, but requires close bacteriological monitoring.

(2) Water without a halogen residual received from approved sources or water produced on board must be chlorinated or brominated to provide at least 0.2 ppm halogen residual (FAC/TBR) at the end of a 30-minute contact time (CT) in the potable water tanks.

(3) Chloramines in lieu of chlorine are used in many municipal public water systems to reduce disinfection by-products. To determine disinfectant residual for systems which use chloramines measure the total chlorine residual in lieu of FAC. At least 2.0 ppm total chlorine residual should be present in the municipal water source at the pier riser.

(4) Water received from an unapproved source, a source of doubtful quality, or an area where amebiasis or infectious hepatitis is endemic, must be chlorinated or brominated to provide at least a 2.0 ppm halogen residual (FAC/TBR) at the potable water tanks at the end of a 30-minute contact time. In these instances, if the ship's brominator cannot achieve a TBR of 2.0 ppm, the water must be chlorinated by the “batch method” to obtain not less than 2.0 ppm FAC at the potable water tank after 30-minute contact time. After 2.0 ppm halogen is maintained for 30 minutes in the potable water tank, the water is considered safe for use.

6-22. Disinfection of Potable Water Tanks and Systems

a. Mechanical cleaning of tanks includes all measures necessary to clean tanks of foreign materials, rust, and other substances that are present within the tanks.

b. There are two types of disinfection procedures:

(1) Mechanical cleaning with chemical disinfection.

(2) Chemical disinfection.

c. Mechanical cleaning and chemical disinfection will be accomplished when the condition of a tank has deteriorated to the point where the chlorine demand has increased significantly and bacteriological test results indicate the tank water quality is unacceptable. After any tank has been mechanically cleaned, it will be chemically disinfected in accordance with Table 6-2. Mechanical cleaning and chemical disinfection must be accomplished under the following conditions:

(1) Tanks of new ships or tanks which have been repaired.

(2) Where sludge or rust accumulation seriously impairs the quality of water.

(3) Tanks that have been loaded with non-potable, ballast water.

d. Chemical disinfection is required when the following conditions exist:

(1) Tanks in which there is continued bacteriological evidence of contamination after normal disinfecting procedures.

(2) Pipelines, valves, pump, etc., that have been dismantled, repaired, or replaced.

(3) Tanks which have been entered.

Table 6-2. Methods for Disinfection of Potable Water Tanks*
(Reference: ANSI/AWWA Standard C652-02)**

METHOD 1	METHOD 2	METHOD 3
Fill tank to over flow level	Spray/apply directly 200 ppm FAC to all tank surfaces	Fill 5% of tank volume with 50 ppm FAC solution
Add chlorine to achieve 10 ppm FAC throughout the tank	Flush inlet/outlet pipes with 10 ppm FAC	Hold solution for 6 hours
Hold this solution for 24 hours	Disinfected surfaces shall remain in contact with chlorine solution for a minimum of 30 minutes	Add potable water to chlorine solution to fill tank; hold this water for 24 hours
Drain tank	Refill tank with potable water with required halogen residual level	Drain tank
Refill tank with potable water with required halogen residual level		Refill tank with potable water with required halogen residual level
Perform bacteriological testing of potable water		
Upon satisfactory bacteriological testing and asthetic quality water may be delivered to the system		

* Table reads from top to bottom, not left to right.

** American Water Works Association (AWWA).

e. Highly chlorinated water discharges shall comply with Federal, State, local, or host nation environmental regulations. Special provisions or permits may be required prior to discharge of highly chlorinated water. Local authorities shall be contacted prior to disposal of highly chlorinated water. American Water Works Association Standard ANSI/AWWA C652-02, Appendix B provides guidance for neutralizing highly chlorinated water.

6-23. Disinfection of Potable Water Hoses, Tapes, and Rods

a. Potable water hoses are disinfected by filling with a solution containing 100 ppm FAC. The solution must be in contact with the entire hose interior for 2 minutes. Flush the hose for a minimum of 30 seconds with potable water prior to use.

b. Prior to connecting the potable water to either the ship riser or the shore source, the interior of the fittings shall be disinfected by not less than 2 minutes contact with a solution of 100 ppm FAC. The shore water source should be flushed to waste 30 seconds prior to hookup of the water hose.

c. Disinfection of sounding tapes or rods may be accomplished by wiping the rod or tape with a 100 ppm FAC solution or other suitable disinfectant compatible with potable water, (for example, food contact surface disinfectant such as liquid iodine, or isopropyl alcohol soaked gauze).

6-24. Emergency Disinfection of Water for Drinking and Cooking Purposes. If an approved potable water source is not available it may be necessary to treat an unapproved water source for drinking and cooking purposes in an emergency situation. The water to be treated should be as clear as possible. Before human consumption, this water shall be chlorinated initially to at least 5.0 ppm FAC with a minimum 30 minute contact time. Water at the point of consumption shall have a final residual of at least 2.0 ppm FAC. Water can also be made safe by holding at a rolling boil for 2 minutes. Water taste complaints may be anticipated with chlorine residuals above 1.0 ppm FAC but higher levels of FAC needed to ensure water is safe to drink. If the water is excessively contaminated or turbid, consideration should be given to the use of canned, bottled, or other emergency drinking water sources.

6-25. Chlorine Dosage Calculator

a. **Theory of operation**

(1) Tables 6-3, 6-4, and 6-5 provide chlorine dosage rate information. The quality of water, e.g., the organic and inorganic materials present, will affect the final chlorine residual. The amount of chlorine required to react with and be absorbed by these materials is called the "chlorine demand." The chlorine absorbed or neutralized has no disinfectant value, so it is necessary to add enough chlorine (adequate dosage rate) to satisfy the "chlorine demand" and still provide FAC. The FAC is the active disinfecting agent and is the chlorine reading determined with the colorimetric test kit. Table 6-6 provides required halogens residuals.

(2) As a rough calculation, a dosage rate of 1-ounce of HTH (65-70%) mixed with 5,000 gallons of water yields 1.0 ppm FAC. Because of chlorine demand, this dosage rate will probably produce a FAC residual of about 0.2 ppm after a 30-minute contact time.

b. **Instructions for use**

(1) Select desired parts per million. Determine strength of chemical to be used. Compute number of gallons to be chlorinated. Read across to obtain quantity of material to be used.

(2) The 5% and 10% listings are liquid sodium hypochlorite (unscented); thus, the measurements are expressed as volume. (Table 6-4 and Table 6-5 respectively.)

(3) The 65-70% listings are granular calcium hypochlorite; thus, the measurements are expressed as weight. (Table 6-6).

c. The standard 2 ½ inch water hose has a volume of 0.25 gallons per foot of hose. This figure may be used in determining the volume of a hose for disinfecting purposes. Volumes for other size hoses may be found in the NAVMED P-5010-5, Water Supply Ashore.

Table 6-3. Chlorine Dosage Calculator for 5% Liquid Sodium Hypochlorite (Unscented)

Tsp = teaspoon Tbsp = tablespoon 3 Tsp = 1 Tbsp 2 Tbsp = 1 Oz Qt = quart Gal = Gallon

QUANTITY (GAL.)	PPM 1	PPM 5	PPM 25	PPM 50	PPM 100	PPM 200
50,000	1 Gal.	5 Gal.	25 Gal.	50 Gal.	100 Gal.	200 Gal.
25,000	2 Qt.	10 Qt.	50 Qt.	25 Gal.	50 Gal.	100 Gal.
10,000	26 Oz.	1 Gal.	5 Gal.	10 Gal.	20 Gal.	40 Gal.
5,000	13 Oz.	2 Qt.	10 Qt.	5 Gal.	10 Gal.	20 Gal.
2,000	6 Oz.	26 Oz.	1 Gal.	2 Gal.	4 Gal.	8 Gal.
1,000	3 Oz.	13 Oz.	2 Qt.	1 Gal.	2 Gal.	4 Gal.
500	2 Oz.	7 Oz.	1 Qt.	2 Qt.	1 Gal.	2 Gal.
200	1 Tbsp.	3 Oz.	13 Oz.	26 Oz.	52 Oz.	103 Oz.
100	2 Tsp.	2 Oz.	7 Oz.	13 Oz.	26 Oz.	52 Oz.
50	1 Tsp.	1 Oz.	4 Oz.	7 Oz.	13 Oz.	26 Oz.
25		1 Tbsp.	2 Oz.	4 Oz.	7 Oz.	13 Oz.
10			1 Oz.	3 Tsp.	3 Oz.	6 Oz.
5			1 Tsp.	5 Tsp.	2 Oz.	3 Oz.

Table 6-4. Chlorine Dosage Calculator for 10% Liquid Sodium Hypochlorite (Unscented)

QUANTITY (GAL.)	PPM 1	PPM 5	PPM 25	PPM 50	PPM 100	PPM 200
50,000	2 Qt.	10 Qt.	50 Qt.	25 Gal.	50 Gal.	100 Gal.
25,000	1 Qt.	5 Qt.	25 Qt.	50 Qt.	25 Gal.	50 Gal.
10,000	13 Oz.	2 Qt.	10 Qt.	5 Gal.	10 Gal.	20 Gal.
5,000	7 Oz.	1 Qt.	5 Qt.	10 Qt.	5 Gal.	10 Gal.
2,000	3 Oz.	13 Oz.	2 Qt.	1 Gal.	2 Gal.	4 Gal.
1,000	1.5 Oz.	7 Oz.	1 Qt.	2 Qt.	1 Gal.	2 Gal.
500	1 Oz.	4 Oz.	1 pt.	1 Qt.	2 Qt.	1 Gal.
200	2 Tsp.	2 Oz.	7 Oz.	13 Oz.	26 Oz.	55 Oz.
100	1 Tsp.	1 Oz.	4 Oz.	7 Oz.	13 Oz.	26 Oz.
50		0.5 Oz.	2 Oz.	4 Oz.	7 Oz.	13 Oz.
25		2 Tsp.	1 Oz.	2 Oz.	4 Oz.	7 Oz.
10		1 Tsp.			2 Oz.	3 Oz.
5					1 Oz.	2 Oz.

Table 6-5. Chlorine Dosage Calculator for 65-70% Powder Calcium Hypochlorite

Weight: 16 Oz. = 1 lb.

QUANTITY (GAL.)	PPM 1	PPM 5	PPM 25	PPM 50	PPM 100	PPM 200
50,000	10 Oz.	3 lb.	15 lb.	30 lb.	59 lb. 9 Oz.	119 lb. 4 Oz.
25,000	5 Oz.	24 Oz.	7.5 lb.	15 lb.	29 lb.12 Oz.	59.5 lb.
10,000	2 Oz.	10 Oz.	3 lb.	6 lb.	12 lb.	23 lb. 13Oz.
5,000	1 Oz.	5 Oz.	1.5 lb.	3 lb.	6 lb.	11 lb. 15 Oz.
2,000		2 Oz.	10 Oz.	19 Oz.	2 lb. 7 Oz.	4 lb.13 Oz.
1,000		1 Oz.	5 Oz.	10 Oz.	20 Oz.	2 lb. 7 Oz.
500			3 Oz.	5 Oz.	10 Oz.	19 Oz.
200			1 Oz.	2 Oz.	4 Oz.	8 Oz.
100				1 Oz.	2 Oz.	4 Oz.
50					1 Oz.	2 Oz.
25						1 Oz.

6-26. Required Halogen Residuals

Table 6-6. Required Halogen Residuals

Treatment Required	Chlorination Dosage And Contact Time Requirements (FAC)	Bromination Dosage Requirements (TBR)
Water in potable water distribution system	0.2 ppm Note: trace allowed in far ends of distribution (pipng) system for large water distribution systems such as found in an aircraft carrier.	0.2 ppm Note: trace allowed in far ends of distribution (piping) system for large distribution systems such as found in an aircraft carrier.
Water from unapproved source (emergency-use)	2.0 ppm at point of consumption	Not applicable
Disinfecting tanks and system	See Table 6-3	Not applicable
Disinfecting hoses, couplings, and water connections prior to connection to potable water system.	100 ppm with 2 min. contact time	Not applicable

SECTION V. POTABLE WATER, SUBMARINE/YARD CRAFT

6-27. Submarines

a. Submarines are generally exempted from routinely halogenating potable water. However, some submarines have been retrofitted with an in-line brominator unit. If bacteriological testing indicates positive coliform bacteria then the potable water supply shall be treated with either calcium hypochlorite (65-70%) or bromine until a residual of 0.2 ppm FAC or TBR as applicable is obtained with a minimum 30 minutes contact time. Halogen residual must be maintained until repeat bacteriological testing indicates water is safe. When using calcium hypochlorite (HTH), the submarine atmosphere must be monitored for chlorine gas. If the gas exceeds safe limits, the emergency procedures described in the Atmospheric Control Manual must be followed.

b. Cleaning and disinfecting tanks are outlined in Article 6-22.

c. In accordance with COMSUBLANT/ COMSUBPAC 6000.2 series, the following minimum storage quantity of HTH will be carried on board submarines of the Force:

(1) SSN - 9 six oz. bottles.

(2) SSBN – 12 six oz. bottles.

d. The individual bottles of HTH must be sealed in plastic bags and stored only in a medical instrument box, plastic rigid, size 9½ x 9 x 7 inches, NSN 6545-00131-6992. The case must be painted white and labeled: "HAZARDOUS MATERIAL, CALCIUM HYPOCHLORITE" in red letters. The case must be vented at the bottom and be stored in any area away from engineering spaces.

e. Each bottle of HTH shall be inspected prior to deployment or at least every 3 months. Bottles with deteriorated seals must be discarded and replaced.

f. Bacteriological examination of potable water shall be performed weekly on a minimum of four samples representative of the distribution system. Any EPA approved method for bacteriological testing may be used. Either Colilert® or Colisure ® Tests are generally used for simplicity considerations. The results of all testing will be reported as "presence" or "absence."

(1) Submarines alongside a tender may establish a schedule for weekly testing of potable water samples by the tender while in port. But in all cases, weekly testing will be accomplished while at sea or in port.

(2) Daily halogen residuals will be performed and recorded while in port using a shore water supply.

(3) The MDR shall maintain a potable water log including water source, date, bacteriological testing, any disinfection procedure used, and halogen readings.

g. Color-coding, labeling, disinfection, and storage of potable water hoses are covered under Section III, Articles 6-19 and 6-20 and Section IV, Article 6-21 of this chapter.

6-28. Yard Craft

a. Yard craft has been defined to include barges, tugs, and other vessels capable of independent movement within the harbor, but not routine ocean-going travel. These vessels usually have no water producing capability; potable water is transferred from a shore facility. Most yard craft are equipped with a potable water storage tank and a limited distribution system. Disinfection of the water is not necessary when water is transferred from an approved potable water source. Most problems associated with contamination of water aboard yard craft are usually the result of improper transfer procedures.

b. Daily testing for halogen residual is not usually performed due to the lack of personnel and equipment. The MDR shall maintain close contact with the port services officer (PSO) and will provide surveillance procedures to ensure a safe water supply.

c. The PSO and the local MDR shall develop and implement a system for collection and examination of water samples for each group of yard craft. Water samples for bacteriological analysis must be collected from each craft water tank and distribution system on a weekly basis. In the event of bacteriological contamination of the water supply, the MDR shall investigate the source of contamination and provide recommendations regarding correction and disinfection. It may be necessary for the MDR to supervise disinfection operations.

SECTION VI. CARGO WATER

6-29. Emergency Use of Potable Water Tanks for Ballast

a. Potable water tanks and pipelines which will be filled with any non-potable liquid for ballast or other emergency purposes must be disconnected and sealed off at the tanks. It shall not be reconnected until the contaminated tank, piping, and fittings have been properly cleaned and disinfected.

b. Water placed in these tanks must not be used for drinking or cooking purposes until it has been adequately cleaned/disinfected and a bacteriological analysis confirms water is safe for human consumption. If bacteriological tests are positive, the disinfection process must be repeated until such time as bacteriological analysis is negative prior to the system being placed in service. Chemical testing of water may be also necessary to ensure water is safe for human consumption if there is concern for chemical contamination.

6-30. Handling of Cargo Water

a. **Water Ships, Barges, and Yard Craft**

(1) Water must be taken from approved watering sources as specified in Article 6-6.

(2) The water must be transferred in a manner that prevents contamination in accordance with Article 6-9.

(3) Vessels transporting potable water must maintain records of the following:

(a) Source of water (indicate whether or not from an approved source).

(b) Daily halogen residual.

(c) Results of bacteriologic testing.

(d) Above information shall be provided to the receiving ship prior to transfer.

(4) Water vessels shall deliver potable water to receiving ships with a halogen residual of at least 0.2 ppm when the source is an approved watering point. If the halogen residual is below 0.2 ppm, sufficient chlorine or bromine shall be added to by the receiving ship to boost halogen residual to 0.2 ppm with a 30-minute contact time at the potable water tank.

(5) Water received from an unapproved source must be halogenated to provide at least 2.0 ppm residual with a 30-minute contact time at the potable water tank.

b. **Receipt of Cargo or Transferred Water**

(1) The MDR of the receiving ship shall test the halogen residual of water to ensure minimum halogen residual of 0.2 ppm is present.

(2) If the water does not contain a halogen residual of at least 0.2 ppm, it will be necessary for the engineering department to treat the water in the receiving tanks prior to piping to the distribution system.

(3) If the water is from an unapproved or questionable source, the MDR shall conduct bacteriological testing of the water prior to and after adequate disinfection to 2.0 ppm in the distribution system to ensure bacteriological quality.

(4) The MDR shall ensure that appropriate entries are documented in the potable water log regarding source, halogen residual, bacteriological testing, and recommendations.

6-31. Temporary Water Tanks. In emergency situations to convert tanks commonly used for other liquids for transporting potable water, the following considerations should be taken into account for temporary storage and transfer of potable water:

a. **Tank Selections and Preparation**

(1) Paint coating of tanks for transport shall be listed with NSF/ANSI Standard 61 for potable water tanks and NSTM, Chapter 631.

(2) When the tanks are cleaned and all surfaces are viewable, they must be inspected by designated engineering personnel. The following conditions should be considered:

(a) Well-adhered coating.

(b) Total dry-film thickness.

(c) Excessive rust.

(d) Completeness of coatings.

(e) Blistering and peeling.

(f) Water-tight integrity, especially inner-bottom tanks.

(g) Any other potable water degrading conditions.

(3) Following the results of the inspection of all tanks, the appropriate Type Commander should decide on the approval or disapproval of these tanks for transporting and storage of potable water. If final approval is granted, necessary repairs, maintenance, and cleaning identified during the inspection should be instituted. A thorough cleaning of all tank surfaces, piping, pumps, etc., will be necessary using the following guidelines:

(a) Using high-pressure spray, clean all tank surfaces with potable water. When cleaning chemicals are used, they shall be listed in NSF/ANSI Standard 60 as approved additives.

(b) Remove all scaling and rust.

(c) Pumps shall be dismantled and cleaned with potable water and approved additive. Remove and replace all gaskets. The replacement gaskets shall be of material approved for use with potable water system NSF/ANSI Standard 61.

(d) All lines shall be flushed with potable water and approved additive as referenced above.

(e) Obtain a diagram of the pumping and distribution system, and complete the following procedures:

1. Identify all parts of the system to be used for potable water handling, and color code for identification. The color code for potable water systems is dark blue, as outlined in NSTM, Chapter 505, Piping Systems.

2. Using blank flanges or caps, blank off all piping, which is not to be used for potable water transfer. Separation by valve closure is not considered adequate safeguard against cross connections.

3. Identify water collection points on each tank for testing purposes. Identify chlorine introduction points for each tank.

(f) Complete tank cleaning and repair.

(g) A final inspection should be conducted to assure that all repairs and cleaning have been adequately accomplished.

(h) Disinfect tanks and related piping in accordance with Article 6-22. Force ventilate the tanks for 8 hours to air dry.

(i) Vents to all potable water tanks must be screened with 18-mesh or finer non-corrosive wire and must not terminate in spaces where contamination may be transmitted to the water.

b. **Transfer of Water for Use**

(1) Water transferred from the ship for human consumption will contain 2.0 ppm FAC.

(2) Water transferred from the ship for human consumption will be absent of total and fecal coliform bacteria. A bacteriological analysis must be conducted no later than 1-week prior to transfer.

(3) Properly trained shipboard personnel shall monitor the procedures used for transfer of potable water from the ship. Hoses previously used for fuel or other liquids shall not be used for the transfer of potable water. Only hoses approved for contact with potable water shall be used for transferring potable water.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION VII. EMERGENCY WATER SUPPLIES

6-32. Battle Dressing Stations

a. Ships are equipped with built-in potable water storage tanks in battle dressing stations to provide an emergency potable water source. The tanks are designed for gravity flow and are isolated from the main potable water system. A piping diagram shall be provided for each tank with appropriate instructions for filling and emptying.

b. Follow all Maintenance Requirement Card (MRC) procedures. Once a quarter all emergency potable water storage tanks must be drained and refilled with potable water containing a minimum trace halogen residual.

6-33. Emergency Potable Water, 5-Gallon Containers

a. Some small ships store emergency potable water supplies in 5-gallon potable water approved containers due to the lack of an emergency tank in the battle dressing stations. These containers may be filled with water produced on board or from approved shore facilities. This storage is acceptable provided the containers have been properly cleaned and disinfected prior to filling.

b. Only approved 5-gallon potable water containers shall be used for the storage of potable water. Under no circumstances will 5-gallon containers previously used for gasoline or other petroleum products be used as emergency potable water containers aboard ship.

c. Examination of water containers prior to disinfection and filling.

(1) The initial step consists of careful examination of the containers to ensure the containers have not been used for any purpose other than the storage of potable water. Each container shall have the word "POTABLE WATER" either embossed or painted on the exterior surface in letters at least 1-inch high.

(2) Each container will then be physically inspected for the following conditions:

(a) Evidence of rust or corrosion, either interior or exterior.

(b) Evidence of open seams or breaks in the surface.

(c) Interior coating of metal container not uniform, cracked, pitted, or peeled away.

(d) Any evidence of dirt, grit, organic matter, or other substance embedded in the interior surface of the container.

(e) Carefully inspect the cap to ensure that it seats properly.

(f) Inspect the gasket to ensure that it is properly fitted and not deteriorated. If deterioration of the gasket is evident, it must be replaced prior to use.

(g) Inspect the locking lever to ensure that it works properly by engaging the seat or lock ring cam lugs.

(h) Inspect the carrying handles to ensure that they are properly attached and in good repair.

d. Manual washing is accomplished with warm water (110-125° F), the recommended amount of approved food service dishwashing detergent, and a suitable long-handled, slender brush. (General-purpose detergent shall not be used to clean emergency water containers because it may cause adverse health effects.) Thorough rinsing with potable water is necessary after cleaning.

e. All interior surfaces shall be disinfected by exposure to a chemical disinfectant solution for at least 2 minutes. Approved chemical disinfectants for these containers include: calcium and sodium hypochlorite. Refer to Article 6-25 for guidance in chlorine dosage calculation.

f. Potable water used for filling emergency containers must contain a trace FAC or TBR (preferably 0.2 ppm or greater).

g. Each can shall be labeled with date of filling and source of the potable water.

h. The 5-gallon containers shall be stored in a clean dry place in the immediate vicinity of anticipated use (battle dressing station without emergency potable water tanks).

i. These containers shall be emptied, flushed, and refilled with potable water containing a trace FAC or TBR (preferably 0.2 ppm or greater) quarterly.

j. Halogen residual and bacteriological tests are not required.

6-34. Can and Bottle Drinking Water. If canned drinking water is stored for emergency use in boats, rafts, battle stations, battle dressing stations, or storerooms it must be inspected in accordance with PMS requirements. Bottle water shall be procured only from DOD approved sources.

SECTION VIII. EVALUATION OF TASTE AND ODOR PROBLEMS

6-35. General Evaluation of Taste and Odor Problems. A ship is a mobile vessel and must rely on a variety of water sources: shore, barge, other ships, etc. There is a variety of shipboard piping systems, which, if not isolated, may be a source of unsafe cross connections to the potable water system. The uniqueness of the shipboard environment, the complexity of piping systems, and multiple sources of water may individually, or in combination, be a factor in the source of taste and odor problems aboard ship. Taste and odor problems are primarily aesthetic, but are causes for concern aboard ship due to the negative effect in the morale of personnel. Most individuals are extremely sensitive to taste and odor. Aboard ship, there are no water treatment processes to easily control taste and odor problems that may develop. Water produced by the ship water plant is good quality and is the least likely source of problems.

6-36. Causes of Taste and Odor in Potable Water

a. The following conditions or situations have been identified as causes of potable water contamination resulting in severe taste and odor problems aboard ship. Taste and odors potable water problems may be related to below factors:

(1) Cross connections with non-potable systems.

(2) Leaks in common bulkheads between potable water tanks and fuel tanks, ballast tanks, bilges, and wastewater tanks.

(3) Leaks in non-potable piping through water tanks.

(4) Improper disposal of chemicals or liquids through potable water-sounding tubes.

(5) Potable water hoses used for non-potable liquids.

f. Excessive storage time of water in tanks.

g. Shipboard water production from contaminated raw water source.

h. Inadequate disinfection procedures resulting in development of chlorine by products.

i. Transfer of water from shore facilities or barges, which have taste and odor problems.

j. Potable water tanks used for non-potable water liquids.

k. Deteriorated, improperly applied (cured/vented) tank coatings.

l. Shipboard water treatment plants producing potable water while stripping fuel tanks, pumping oily bilges overboard forward of the distilling plant feed pumps suction or when in close proximity to other ships.

6-37. Indicators of Taste and Odor Problems

a. The MDR is responsible for surveillance of the potable water system. Usually this function is accomplished through determination of chlorine or bromine residuals from representative areas of the ship on a daily basis and bacteriological testing of the potable water on a weekly schedule. This testing, as well as complaints from the crew, can be very helpful in identifying and locating the source of the taste and odor problems.

(1) **Crew Complaints.** Initial complaints from the crew can provide important data, particularly if the complaints are associated to a specific location and related to a specific time pattern. All of these factors can be compared to a particular tank in use, the disinfection processes for the tank, and the piping system associated with the tank. Each item of information is important when investigating taste and odor complaints.

(2) **Bacteriological Testing.** If the cause or source of the taste and odor problem is a result of organic growth (biofilm) in the tanks, the standard shipboard bacteriological test (Colilert®) is not useful in identifying taste and odor-causing bacteria. The bacteriological testing method performed by MDR is designed solely to identify the presence or absence of coliform bacteria, which is the indicator organism for bacteriological drinking water quality. Therefore, bacteriological testing of the ship water supply may be consistently negative, but the source of taste and odor problems could still be the result of growth of other microorganisms in the tanks and distribution system.

(3) **Halogen Residuals (FAC/TBR).** Maintenance of halogen residual is directly affected by the microbiological and chemical quality of the water. Loss of halogen residual may be an indicator of contamination or biofilm buildup in tanks or piping.

b. Chlorine or bromine, react with virtually any substance in water and through this process, may be neutralized. The use of the disinfectant in a water supply is referred to as "halogen demand." The halogen demand in any water supply will vary with respect to the amount of interfering or neutralizing substances present, which will reduce the initial supply of chlorine or bromine added to the water. This is a complex problem, which can be summarized for medical surveillance purposes as follows: if the proper amount of chlorine or bromine has been added to the potable water tanks and no halogen residual is present or it dissipates in the distribution system, this is indicative that some substance has used or neutralized the halogen in the system. The lack of ability to maintain a halogen residual in the tanks or the potable water system indicates that the chlorine or bromine is reacting with some substance, which may be the source of the taste and odor problem. The causes of taste and odor problems are quite varied; however, a systematic approach may lead the resolution, or at least provide initial data for more experienced investigators.

6-38. Initial Evaluation of Taste and Odor Problems. The following statements and questions represent an investigative approach to taste and odor complaints. The evaluation of these items by MDR may result in identification of the source of the problem. If not, a great deal of initial evaluation has been conducted and will provide a baseline of information for personnel from Navy Environmental and Preventive Medicine Units (NAVENPVNTMEDUs) or other organizations tasked to assist.

a. When was the problem first noticed or initial complaints received? This date and time may be related to a particular tank, a section of the piping system or repairs and maintenance associated with the system.

b. What is the source of the water?

(1) Shore (direct pressure).

(2) Ship's tanks filled with shore water.

(3) Mixture of water remaining in ship's tanks and shore water.

(4) Barged water.

(5) Another ship.

(6) Produced by ship's water plant.

c. Does the water have a characteristic taste or odor? It is sometimes possible to determine the source of a water problem through a characteristic taste or odor.

d. Is the problem isolated to one section of the ship, or does it occur throughout the ship? If the problem is limited to a particular section of the ship, the investigation should be oriented to occurrences affecting the piping system or tank supplying that section of the ship. Cross-connections, repair or maintenance of the piping systems, sounding tubes, and a particular tank are possible sources of the problem.

e. Is the problem continuous or does it occur only while a particular tank is on-line? If the problem appears to be cyclic, compare the record of complaints and the particular tank(s), which are supplying water to different sections of the ship. Ongoing halogen residual testing may indicate increased halogen demand in the tank or particular sections of the piping system.

f. Can halogen residuals (FAC/TBR) be maintained in the potable water tank? Engineering halogen testing at the potable water tanks may indicate increased halogen demand due to contaminants.

g. Has the ship experienced similar taste and odor problems in the past? Discussion with engineering personnel may provide information associated with a similar problem in the past.

h. Review the potable water log to identify fluctuations, which may be occurring in the potable water distribution system. This is easily accomplished by plotting a simple graph with halogen residual levels on the vertical axis and days on the horizontal axis. If this data can be plotted for the past 3 months, an accurate picture can be developed. Compare this data with the source of the water and tanks, which were on-line at the time. Perhaps a pattern will develop associated with a particular source of water or an individual tank.

i. Identify potable water tanks with common bulkheads to fuel, ballast, other tanks, or bilges. A potable water tank with a common bulkhead to bilges or other tanks containing fuel or ballast and small leaks could be a persistent source of taste and odor problems. Identification of these tanks or associated non-potable liquids, which may contaminate the potable water system, must not be overlooked as the source of that problem.

j. Identify any non-potable piping, which has been permanently installed through potable water tanks. Any piping through potable water tanks should be enclosed in self-draining pipe tunnels to avoid contamination of the water system. In many instances, evaluation of this piping can only be accomplished upon entrance to the tanks, but MDR should be aware of the location and existence of this type of piping.

k. Review potable water disinfection procedures to ensure that engineering personnel follow proper procedures. The engineering department is responsible for potable water treatment. The MDR shall have a basic understanding of the system and review the procedures for disinfecting to ensure that the proper amounts of halogens are being added to achieve the prescribed halogen residuals in the distribution system.

l. Identify any repair or maintenance operations conducted on the potable water distribution system, which could have contributed to the taste and odor problem. There are numerous points in the potable water system, which can become a source of contamination through either cross-connections or as a result of repair or maintenance procedures. The operations should be reviewed and correlated to the location within the system, for possible sources of contamination.

m. Has medical water quality surveillance been maintained for the potable water tanks while the ship is at the pier on direct service? Water remaining in potable water tanks is ignored when the ship is tied up to the pier. Consequently, the water sits for long periods of time and may become stagnant and provide a source for taste and odor problems immediately upon resumption of tank usage.

n. Are potable water tanks evaluated through halogen testing or bacteriological analysis prior to filling the tanks with shore water? If the tanks are filled with water from a shore source and mixed with water, which has remained in the tanks for extended periods of time, taste and odor problems may occur. It is recommended that the water in the tank be evaluated for adequate halogen residual and bacteriological analysis prior to filling with shore water.

o. Identify the type of paint coating, date, and location of application for each potable water tank. An improperly cured or applied potable water tank coating may be the source of a temporary or permanent taste and odor problem. Usually the evaluation of the tank coating is not a function which can easily be conducted by shipboard personnel. A temporary taste problem following application of new tank coatings is not unusual, but should resolve following usage of the tanks. In contrast, lack of ability to maintain halogen residuals in the tanks accompanied by persistent taste and odor problems may be directly related to an improperly applied or uncured tank coating.

6-39. Control Measures for Taste and Odor Problems

a. As previously indicated, mechanical processes for the control of taste and odor are quite limited aboard ship. Identification and elimination of the source of the taste and odor is an important quality of life issue and may be a significant health concern. If the ship is at sea and the system must be used, increasing the residual chlorine levels can be used to aid in the control of taste and odor problems.

b. Increased residuals have been and are still being used as a control measure for taste and odor in municipal water supplies ashore. The elevated chlorine residuals often satisfy the halogen demand that may be present in the tanks or piping system. Therefore, ships that have not been able to identify a source of the taste and odor, should add sufficient chlorine to provide a dosage of 5.0 ppm in the potable water tanks, with the intent of providing 2.0-ppm free residual chlorine in the water distribution system. This procedure may satisfy the halogen demand in the tanks or system and resolve taste and odor problems of a temporary nature.

c. Steam application has been successfully used in treatment of taste and odor problems associated with improperly applied potable water tank coatings. Ship personnel with outside assistance from NAVSEASYSCOM can accomplish the actual steam application procedure. The use of steam application to identify uncured coatings should not be accomplished without prior approval of NAVSEASYSCOM. Prior to use of steam application to any potable water tank, it is necessary to have at least some idea as to the success of the operation. This may be readily accomplished by boiling some of the bad tasting water for approximately 1 minute. If the taste and odor have been resolved through heating the water, there is a reasonable measure of success implied in the use of steam treatment of the tanks. If the taste and odor have not been eliminated through boiling of the water, steam treatment will most likely be unsuccessful.

6-40. Request for Outside Assistance

a. If the evaluation procedures outlined in Article 6-36 have been conducted and no source can be determined for the taste and odor problem, it is recommended that the area NAVENPVNTMEDU be contacted via the type command medical officer for technical assistance. Medical and appropriate engineering personnel should be prepared to discuss the evaluation of specific items outlined in Article 6-38.

b. NAVENPVNTMEDU personnel will provide consultative assistance for shipboard taste and odor problem upon request. If the NAVENPVNTMEDU personnel cannot provide onboard assistance due to geographical location, the preventive medicine assistant (PMA) from the nearest naval hospital may be requested to provide onboard assistance in reviewing the problem.

c. Following a thorough review of the situation, the NAVENPVNTMEDU personnel will provide appropriate recommendations for resolution of the taste and odor problem. If the problem cannot be resolved, or is suspected to involve tank coatings, a summary of investigative results will be provided to the ship with a recommendation to notify NAVSEASYSCOM, Washington DC, via the chain of command. The NAVSEA chain of command includes the applicable Naval Sea Support Center (NAVSEACEN) or In-Service Engineering Agent (ISEA). NAVENPVNTMEDU personnel will assist engineering personnel or NAVSEASYSCOM representatives in the evaluation and testing of tank coatings aboard the ship.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION IX. CROSS-CONECTIONS

6-41. General Cross-Connections. Contamination of potable water through the presence of piping cross-connections has been responsible for numerous water-borne disease outbreaks. In recent years, the potential for cross-connections between potable and non-potable systems has significantly increased due to the back fitting of sewage collection tanks and associated piping. The MDR and engineering personnel must ensure constant surveillance of the potable water system to prevent cross-connections. In contrast to a shore facility, plumbing aboard ship is a maze of piping systems fitted into a relatively compact space. The numerous separate piping systems carrying fuel, salt water, sewage, potable water, etc., offer distinct possibilities for cross-connections, particularly during repair, modification, or through negligence in operation. List of approved backflow prevention assemblies may be obtained from the Foundation for Cross-connection Control and Hydraulic Research, University of Southern California, Los Angeles, CA 90089-2513.

6-42. Cross-Connection Definitions

a. **Cross-Connection.** A cross-connection is any connection between two separate piping systems, one of which contains potable water, and the other water of unknown or questionable quality or some other substance. This condition may result in the flow of liquid from one system to the other, resulting in contamination.

b. **Backflow and Back-Siphonage.** Both terms indicate a reversal in the direction of flow in a potable water system and the entry of non-potable water or other substances into the potable water.

(1) **Backflow.** Non-potable water or other substances enter a potable water system through a cross-connection when the pressure of the non-potable system becomes greater than the pressure in the potable water system.

(2) **Back-Siphonage.** Non-potable water or other substances are drawn "by suction" into a potable water system through cross-connections or outlets as a result of negative pressure in the potable water system. The risk of back-siphonage is increased when the potable water system is secured during water hours, or for any other purpose.

c. **Submerged Inlet.** A potable water faucet or other outlet, including an attached hose located below the fill level of a sink, tub, container, tank, machine, etc.

d. **Air Gap.** An air gap is the actual vertical separation between a potable water supply outlet and the highest possible level of liquid in the sink, tub, container, tank, machine, etc., receiving the water. The actual distance of separation must be at least twice the diameter of the potable water supply pipe, but never less than 1-inch between the outlet and the highest possible liquid level in the receiving object.

e. **Backflow Preventer.** A device designed to prevent backflow and subsequent contamination of the potable water supply. These devices are installed at locations where there are limited alternatives to cross-connections, e.g., water closets, dish-washing machines, etc. There are numerous types of backflow or back-siphonage prevention devices, the most common being vacuum breakers. The degree of health hazard including whether or not the system is under continuous pressure will dictate the type of backflow prevention device needed. A valve located between a potable and non-potable system is not an acceptable method of cross-connection control.

6-43. Improper Piping Installation. In general, any type of water supply connection that permits the return of used or contaminated water into the potable water system is not permissible. Some examples of improper piping installations of potable water systems that have been observed or identified as the cause of disease outbreaks aboard ship are as follows:

a. **Backflow**

(1) Seawater and potable water lines connected to a common line or outlet.

(2) Direct potable water connections (without backflow prevention devices) to machines, equipment, and non-potable systems.

(3) Boiler feed-water and potable water lines connected to a common line.

(4) Drains from ice machines or food service equipment plumbed directly to the deck drainage or sewage system with no air gap.

b. **Back-Siphonage**

(1) Laundry trays, washbasins, service sinks, and deep sinks with faucets below the fill level.

(2) Drinking fountains with orifice below the fill level, or the vertical jet or orifice supply line surrounded by the waste drain line.

(3) Therapeutic tubs, sitz bath, or steam tables with inlets below the fill level.

(4) Improperly installed water-operation waste ejectors, i.e., dental units, potato peelers, and garbage grinders.

(5) Potable water hose connections installed without vacuum breakers, (backflow preventers) with rubber hoses attached that are allowed to remain in scups, sinks, photo tanks, etc.

6-44. Medical Department Cross-Connection Surveillance

a. The following equipment is normally hard-plumbed or has permanent flexible hose installed and is to be provided potable water via an approved reduced pressure backflow prevention device installed above the overflow level: garbage grinders, x-ray developing machines, photographic chemical mixing tanks, chill water expansion tanks, diesel-engine cooling jacket, and photographic film and print processing machines.

b. Throughout the ship, wherever a hose bib faucet permits connection of a hose to the potable water system, a hose connection vacuum breaker must be installed. Examples are deep sinks, and galley and weather deck wash down faucets.

c. MDR and engineering personnel shall be alert to prevent cross-connections. Modification or repairs to existing potable water systems aboard ship should alert the MDR to the potential for cross-connection problems. Frequent discussion with engineering personnel regarding the potable water system and any repairs or proposed changes may be extremely beneficial in preventing cross-connections. If a cross-connection is suspected or identified, act quickly and effectively to determine if an unsatisfactory condition exists. This is best accomplished through discussion with the engineering officer, a review of the suspected site, and review of ship diagrams. If a cross-connection is identified, immediate action by the MDR and engineering personnel are required. Securing the affected part of the potable water system is appropriate until such time as the cross-connection is eliminated and the potable water system is disinfected, if necessary.

(1) NSF approved tracer dyes are to be used in potable water systems. Fluorescein sodium USP™ and Rhodamine WT™ are EPA-approved dyes and must be used as labeled.

(2) The area NAVENPVNTMEDU can provide additional information concerning safe use of tracer dyes. Standard sea marker dye is not approved for use in potable water systems.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION X. MANUFACTURE AND HANDLING OF ICE

6-45. Manufacture of Ice. This is accomplished aboard ships with ice cube machines or icemakers in most instances. A few small pantries, galleys, general messes and very small ships still maintain ice cube trays for the manufacture of ice. Ice to be used for food or drink and for chilling food must be from a potable water source. Regardless of the end use, all ice must be handled in a sanitary manner and afforded the same protection as water.

6-46. Special Precautions for Handling of Ice

a. Due to the vulnerability of ice to contamination, special precautions regarding handling and storage are necessary.

(1) All ice shall be prepared from potable water.

(2) Ice machines shall be plumbed properly to eliminate the possibility of cross-connections and back-siphonage.

(3) The ice machine drain from the ice storage compartment shall be provided with an air gap between the ice storage compartment and the deck drain.

(4) Ice shall be removed from the storage hop by the use of an ice scoop. The ice scoop shall be stored inside the machine on a bracket above the maximum ice level or outside the ice storage compartment with the handle up in a free draining metal bracket. The design of some ice machines precludes proper storage of the ice scoop inside the machine.

(5) The ice scoop is considered to be food service equipment and, shall be washed, rinsed, and sanitized at least daily as described in NAVMED P-5010-1, Food Safety. For this reason the permanent installation of ice scoops with chains or other permanent attachments is not permitted.

6-47. Cleaning and Disinfecting Ice Machines. Cleaning and disinfection procedures for ice cube machine hops and flaking devices are detailed in Tables 6-7 and 6-8.

Table 6-7. Bulk Ice-Making Machine Cleaning/Disinfection Instructions

STEP	PROCEDURES
1. Turn off motor.	Empty, defrost, and clean. Make certain overflow pipes carry off water used for defrosting.
2. Wash all parts, including ice storage bin.	Use a plastic bristle brush to scrub inside and outside of bins with mild detergent solution.
3. Rinse.	Rinse with water containing at least 50 ppm chlorine to preclude bad odors and the accumulation of film deposits from detergents. Water drain should be clear and free to allow proper rinse.
4. Check Water Control.	Clean to prevent clogging of holes of water flow control.

Table 6-8. Ice Dispensing Machine Cleaning/Disinfection Instructions
(cleaning instruments without unit disassembly)

STEP	PROCEDURES
1. Shut off water.	Pour 1 qt. cleaning solution slowly into water reservoir.
2. Place a container below ice chute in bin and start ice machine.	Ice will be formed from cleaning solution. Discard ice. Shut off machine.
3. Flush ice-making system.	Add 1 qt. cleaning water to reservoir. Catch ice in a container. Discard.
4. Wash down storage bin with mild detergent solution. Rinse.	Scrub interior with a plastic brush and detergent solution. Thoroughly rinse with clean water.

6-48. Bacteriological Quality of Ice

a. Samples of ice shall be collected from 1/4 of the ice machines weekly for bacteriological testing. Ice bacteriological quality shall be absent of both total coliform and fecal coliform bacteria.

(1) Ice sample contamination is usually the result of improper ice handling techniques or dirty storage bins. If samples of ice collected for bacteriological analysis are positive for coliform organisms, the storage bin should be emptied, cleaned, and disinfected.

(2) If samples of ice collected for bacteriological analyses are positive for coliform organisms, the storage bin should be cleaned in accordance with NAVSUP Publication 486. Article 6-22 provides guidance for sanitizing if applicable.

b. Bacteriological examinations of ice samples shall be recorded in the potable water log.

SECTION XI. WATER TESTING REQUIREMENTS AND PROCEDURES

6-49. Scope

a. All testing requirements and procedures are to conform to the latest edition of "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association (APHA), American Water Works Association (AWWA), and the Water Pollution Control Federation (WPCF).

b. The analysis of water for suspected chemical contaminants is complex. The equipment and properly trained personnel necessary for performing these determinations are not available aboard ship. Chemical water quality standards have not been established for shipboard product drinking water. Establishment of chemical potable water quality standards for a moving platform i.e., a ship is problematic. However, bunkering water from a shore facility should meet the EPA, Final Governing Standards, or Overseas Environmental Guidance Baseline Document drinking water quality standards as applicable. EPA has promulgated National Primary and Secondary Drinking Water Standards for pubic water systems. EPA has established Maximum Contaminant Level (MCL) for specific contaminants. However, the risk assessment model used for establishment of MCL health standards is based on the assumption of a person drinking a fixed water source daily for 70 years. Clearly, this is not consistent with health-related exposures for shipboard drinking water. The United States Army Center for Health Promotion and Preventive Medicine Technical Guide 230, "Chemical Exposure Guidelines for Deployed Military Personnel" may be a useful reference in evaluating concerns and complaints regarding the chemical quality of shipboard drinking water. This document sets forth military exposure guidelines (MEG) for drinking water for short-term exposure. While this reference may be helpful in conducting an operational risk management analysis for a shipboard environment one needs to keep in mind this risk assessment model is based on military unit consuming water from a fixed facility such as a field reverse osmosis water purification unit (ROWPU). Afloat commands requiring assistance for a water quality complaints/problems should contact the nearest Navy Environmental and Preventive Medicine Unit.

6-50. Temperature and pH Testing

a. These tests are important to engineering department personnel since deviations of temperature and pH of water may affect the treatment or disinfectant procedures. Halogenation is more effective at lower pH values and at warmer temperatures. High pH levels (8.5 or above) will adversely affect the disinfectant properties of chlorine or bromine.

Water temperature affects the amount of bromine that is released from the cartridge and warmer water temperatures may rapidly affect cartridge utilization.

b. Testing for pH is routinely performed by the Ship's engineering department for boiler feed-water. The test may be used for potable water and is outlined in the Naval Ships Technical Manual, Chapter 220, Volume 2.

c. Testing for pH may also be accomplished using the DPD chlorine-bromine-pH combination test kit, which is a standard stock item.

6-51. Salinity (Chloride Content). Chloride content of water from a distilling plant shall be at or below 0.065 equivalent per million (epm), 0.25 grains of sea-salt per gallon or less than 2.3 ppm. Whenever chloride levels in the potable water exceed those of water produced by distilling plants or initial levels for potable water obtained from shore facilities, contamination of potable water by sea water through leakage may be occurring. Appropriate action including investigation, repair, cleaning, and disinfecting, shall be instituted.

a. Salinity testing is accomplished by the engineering department on ship-produced water.

b. Salinity testing must not be conducted on halogenated water. Water halogenated with calcium hypochlorite may result in false positive readings and titration end points cannot be determined on brominated water. Therefore, routine testing of skin tanks is no longer recommended.

6-52. Halogen Residual (Chlorine/Bromine)

a. FAC and TBR represent the amount of halogen present in potable water following adequate disinfection. FAC is more effective as a disinfecting agent when compared to combined chlorine (chloramines). In contrast, bromamines are very effective disinfecting agents. In the colorimetric test for chlorine the combined halogen is distinguished from FAC by the time at which the color appears after the addition of the color indicator chemical to the water sample. FAC and TBR react rapidly; therefore, an immediate reading of the result is necessary (60 seconds or less).

b. Surface ships must maintain a 0.2 ppm FAC or TBR in the potable water distribution system after initial treatment. Ships with large potable water distribution systems such as aircraft carriers shall maintain at least a trace level of chlorine in the distal ends of the distribution systems. This halogen residual is to be maintained regardless of the source of the water. The initial treatment required must be increased depending on the geographic location of the ship. If water is received from an unapproved source, a source of doubtful quality, the halogen residual at point of consumption shall be a minimum of 2.0 ppm FAC.

c. Chloramines in lieu of FAC are used by many shore water sources because of concerns related to disinfection byproducts formation. The MDR must verify what type of halogen is being used for water treatment. Different testing methods, materials, kits, meters, etc. exist for measuring FAC vs. chloramines (total chlorine). Follow the manufacturer’s recommendations for testing water for the applicable halogen residual.

d. Testing for halogen residuals should be routinely performed by MDR under the following conditions:

(1) Prior to receiving potable water onboard.

(2) In conjunction with each potable water sample collected for bacteriological analysis.

(3) Daily, from sampling points that are varied and are representative of the ship's distribution system (i.e., forward, midships, aft, below deck, and in the superstructure). The number of samples required as specified in Table 6-9.

Table 6-9. Routine Testing Procedure Summary

TESTING	PERSONNEL < 400 CREW	PERSONNEL 400-800 CREW	PERSONNEL > 800 CREW
Halogen Residual (FAC/TBR)	4 Tests Daily	8 Tests Daily	12 Tests Daily
Bacteriological (Potable Water Tanks)	1/4 of Total Number of Potable Water Tanks Weekly		
Bacteriological (Distribution System)	4 Tests Weekly	8 Tests Weekly	12 Tests Weekly
Bacteriological (Ice)	1/4 of Total Number of Ice Machines Weekly		
Emergency Potable Water Tanks	1 Bacteriological Sample Per Tank Monthly		

e. The engineering department is responsible for testing chlorine or bromine residuals in the potable water tanks after 30 minutes contact time. This testing should be considered as part of the evaluation of the treatment process.

f. Chlorine or bromine residuals are determined by using the DPD (diethyl-p-phenylene diamine) test. The DPD test varies in accuracy depending on whether it is formed using a comparator test kit or a portable spectrophotometer. Since the comparator test kits rely on a visual comparison to a color slide or disc, the results depend on the visual acuity of the operator. Consequently, the results from the comparator test kits tend to be semi-quantitative with a ±10% accuracy. Spectrophotometric determination of the halogen residuals alleviates the need to depend on the visual acuity of the operator and can provide an accuracy of +2%. In addition, a number of the DPD test kits provide for the direct determination of both a low range (i.e., 0.1 - 1.00 ppm chlorine) and a high range (i.e., 2 - 10 ppm).

(1) **DPD Test.** The comparator supplied with this test kit gives direct readings for both chlorine and bromine. This chlorine and bromine comparator is read over two ranges. To read the test in low range (0.1 - 1.0 ppm chlorine or 0.2 - 2.2 ppm bromine) place the sample test tube in a slot directly behind one of the colorless windows located on the back of the comparator and read the low-range comparison. To read the test sample in high range (2.0 - 10.0 ppm chlorine or 4.4 - 22.2 ppm bromine) place the sample tube in one of the openings located on top of the comparator and make the reading. The test sample tube is moved from one position to another until a color match is made. A variety of DPD test kits are available and the specific manufacturer's instructions for testing should be followed. The following general procedure is used to obtain both FAC and TBR:

(a) Open potable water tap and let flow not less than 2 or 3 minutes.

(b) Rinse the test tube with the water to be tested.

(c) Fill test tube with sample water to the marked line (10 ml).

(d) Add one DPD No. 1 tablet, cap the test tube, and shake to dissolve.

(e) Remove the cap from the test tube and immediately compare the test sample color with the color standards in the comparator. Color matching shall be completed within 60 seconds after addition of the DPD No. 1 tablet.

(f) Record the value of the matching color standard. If the color falls between consecutive color standards, take an intermediate value. If the color is deeper than 5.0-ppm chlorine or 11.0-ppm bromine color standard, add an additional DPD No. 1 tablet to obtain a full color response. No formulation is required with the extra tablet; take a direct reading and record.

(g) When testing a water supply that uses chloramines as the disinfecting agent, the total residual chlorine can be determined by using a DPD No. 4 tablet. The use of this tablet will not differentiate the type of chlorine, but will indicate the level of total disinfectant present. The test procedures for chloramines (total chlorine) residual are as follows:

1. Rinse the test tube with the test sample, then fill to the mark.

2. Add one DPD No. 4 tablet and allow the tablet to effervesce for rapid disintegration, then cap the test tube and shake to mix.

3. The color that results represents the total residual chlorine.

4. When testing for halogens in the water supply, determine whether bromine or chlorine is being used and record as either bromine or chlorine following testing.

5. When testing for extremely high levels of chlorine, such as superchlorination, it will be necessary to dilute the water to be tested to determine the chlorine residual. Following both the "Standard Methods for the Examination of Water and Wastewater" as well as the "Fourth Edition of the Handbook of Chlorination and Alternative Disinfectants" samples with residuals greater than 4 mg/L must be diluted with halogen-demand-free (distilled) water. A 1:10 dilution using distilled water as the dilutent is satisfactory for this purpose. To determine the chlorine residual a multiplication factor of 10 is necessary.

6. Results of halogen residual tests will be recorded in the water log. Continual absence of halogen residuals in the potable water system must be reported to the commanding officer with a copy to the engineering officer.

(2) **Portable Spectrophotometer** (NSN 6630-01-457-4027) A typical portable spectrophotometer is 3.2 x 6.1 x 15.2 cm (1.25 x 2.4 x 6 inches) in dimension, weighs around 0.19 kg (0.43 lbs) and is battery operated. The advantage for these instruments is they help eliminate human visual subjectivity which occurs with traditional used color comparators kits.

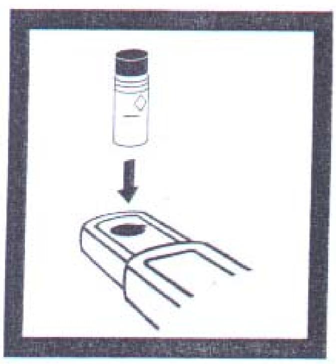
Specific sample volumes, reagents, sample cells and timing intervals for a given procedure depend on the make and model of the instrument. Detailed setup instructions are included with each instrument and should be strictly followed to ensure valid measurements and to prevent damage to the instrument. Portable spectrophotometers are often referred to as portable colorimeters. The NSN number provided is for a pocket colorimeter designed for measuring free and total chlorine only. The manufactured specified reagent must be used for measuring free available chlorine. Pocket colorimeters are available for testing various chemicals. The instrument shown above is microprocessor controlled. The typical procedure for using a portable spectrophotometer consists of the following steps:

1. If your Pocket Colorimeter Instrument requires you set a range before testing, read the **"HI or LO Range Mode"** section in the instrument manual, and set the appropriate range.

2. Fill a clean sample cell to the 10-mL mark with the blank solution (usually untreated sample).

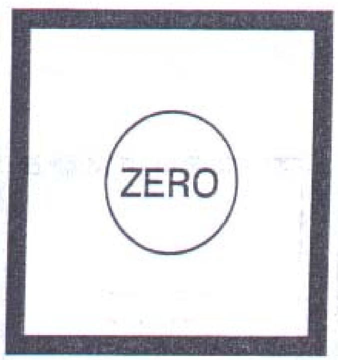
3. Fill another clean sample cell to the 10-mL mark with sample.

4. Add appropriate reagents and mix.

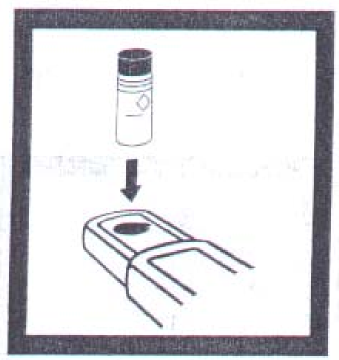


5. Place the blank in the cell compartment with the diamond mark facing the keypad and cover the cell with the light shield.

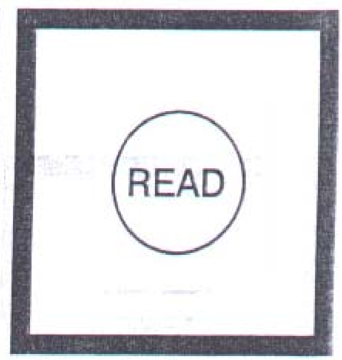
Note: When covering the sample cell, place the curved surface of the light shield closest to the keypad to provide a good seal against stray light.



6. Press the **ZERO** key. After 2 seconds the display will read: 0.00.



7. Place the sample cell containing the sample into the cell compartment (diamond mark facing the keypad) and cover with the light shield.



8. Press the **READ** key. After about 2 seconds the instrument will display the results.

Typical Concentration Ranges for Halogen Determination Using Pocket Colorimeters Determined by the DPD Method

ELEMENT	RANGE (PPM)	SMALLEST INCREMENT
Bromine	0 – 4.5	0.01
Bromine	0 – 10	0.1
Chlorine, free and total	0 – 10 (w/dilution)	0.01
Chlorine, total	0 – 4.5	0.1

6-53. Bacteriological Collection and Testing

a. The bacteriological water quality standard is absence of total coliform and fecal coliform bacteria. The main purpose of the disinfection procedure is to destroy pathogenic organisms present in the water. Adequate water treatment and disinfection is demonstrated by negative bacteriological testing.

b. Bacteriological testing must be completed weekly on samples collected at representative points throughout the distribution system and from one-fourth of the potable water tanks and ice machines on a rotating basis; including potable water retained in storage tanks when under direct service from shore piping. Tank samples should be from petcocks on the tank; if none are available, collect the sample from the outlet nearest the tank. Samples may be obtained from each tank by using the brominator recirculation test taps on ships so equipped. Sample frequency is depending on crew size and shall be done in accordance with routine testing requirements set forth in Table 6-9.

c. Microorganisms of the coliform group are indicators of water contamination. There are numerous EPA-approved methods of testing for total coliforms and fecal coliform. Any EPA approved method may be used. Generally Coliert ® or Colisure ® is used by the fleet.

d. Weekly ice samples must be collected from one-fourth of the ice machines on a rotating basis for bacteriological examination. Bacteriological quality standard for ice is absence of total and fecal coliforms.

e. Collecting and testing for chlorine and bromine residual. Collection and testing of the water for a chlorine or bromine residual is not a part of the coliform test; however, a step-by-step procedure is shown in Appendix C to demonstrate that the residual reading must be taken after the water is allowed to run 2 or 3 minutes and before it is collected in the bacteriological test sample bottle or bag containing sodium thiosulfate.

f. Results of routine medical surveillance bacteriological testing in accordance with Table 6-9 shall be entered in the water log with a weekly report to the commanding officer and a copy to the engineering officer.

g. The presence or absence of total coliform bacteria is the microbiological water quality standard for potable water. The most effective method for minimizing the potential transmission of pathogens is to maintain the required halogen residual levels.

h. Biofilm is the growth of non-pathogenic microorganisms within the ship's potable water system. As these microorganisms grow they can become attached to the surfaces of potable water tanks and piping. Biofilm growth will negatively impact the halogen disinfection efficiency and more importantly may lead to positive bacteriological test results. These biofilms can range from a few organisms scattered along a pipe section to very thick layers reaching several hundred microns in thickness. Maintaining a minimum .2 ppm FAC or .2 ppm TBR residual in the potable water system will help minimize biofilm growth.

i. The bacteria that make up the biofilms are collectively referred to as heterotrophic plate count (HPC) organisms. “Standard Methods for the Examination of Water and Wastewater” (Standard Methods) provides a procedure for enumerating these microorganisms. The HPC method is designed to determine the density of aerobic and facultatively anaerobic heterotrophic bacteria in water. In general, HPC levels greater than 500 bacterial colonies per milliliter are an indication of a loss of microbial control within the potable water piping as well as an indication of potential interference with the coliform measurements. Contact area NAVENVPREV-MEDU for laboratory assistance if HPC testing is indicated.

6-54. Potable Water Log

a. The MDR will maintain a 2-year chronological record of potable water surveillance. On larger ships with preventive medicine personnel, the preventive medicine technician should be responsible for entries. On other ships, the log will be maintained by the MDR.

b. Entries are made in chronological order and must include, as a minimum, the following information:

(1) Time and date each water sample was taken.

(2) Location of the ship: at sea, in harbor, at anchorage, or in port, include the name of the port.

(3) Sampling site: include location of outlet, ice machine, emergency potable water tank or supply, and identification number of potable water tank, etc.

(4) Source of ship’s water from the ship's distilling apparatus, water barge, shore using direct pressure or ships tanks filled with ashore water. Also include information concerning the source of the water (approved or non-approved), its halogen residual and if disinfection was accomplished.

(5) **Medical Surveillance Tests**

(a) **Halogen Residual.** Specify if bromine or chlorine, amount of residual or absence of, reason taken, e.g., daily, bacteriological analysis, water prior to receiving, or in connection with disinfecting tanks or pipes. Include any follow-up action taken when negative readings are obtained.

(b) **Bacteriological Analysis.** Record the results of all testing, including the positive and negative controls. Record the results as total coliform-presence or total coliform-absence. If total coliforms are present then record results of fecal coliform/ E. coli as presence or absence. State reason test performed, such as weekly, special or in connection with disinfecting tanks, pipes or systems. Record action taken and results in the case of positive samples even if the tests were formed by another activity.

(6) Any problems concerning taste and odor and their resolution.

(7) Inspection and surveys include results, discrepancies, and action taken.

c. The use and maintenance of a separate file of DD 686 Bacteriological Examination of Water form is not required if the potable water log is satisfactorily maintained. However, this form should accompany water samples submitted for bacteriological analysis to shore facilities. Results of bacteriological analysis submitted to shore facilities should be recorded in the potable water log. Potable water log documentation using either Shipboard Automated Medical System (SAMS) or using a manual log book is acceptable.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION XII. SAMPLE WATER SANITATION BILL

6-55. Sample Water Sanitation Bill. Each ship shall have a Water Sanitation Bill. The commanding officer should promulgate the Water Sanitation Bill. The bill shall be posted conspicuously in areas where potable water and associated materials are processed, treated, or stored. A sample bill is provided in Appendix D as a guide.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION XIII. REFERENCES AND APPENDICES

6-56. References

a. Although the Manual of Naval Preventive Medicine is widely quoted in reports and publications as an authoritative source, this chapter is published as a guide to aid Medical Department personnel with the inspection and medical surveillance of potable water aboard ship. When making recommendations, other naval manuals, publications, and notices may be referenced and quoted to support this chapter.

b. The following reference materials were used in the preparation of this chapter. It is recommended that each Medical Department procure copies, as needed, for reference and guidance.

(1) OPNAVINST 5090.1 Series, *Environmental and Natural Resources Protection Manual.*

(2) Naval Facilities Engineering Service Center: *Cross-Connection Control and Backflow Prevention Program Implementation at Navy Shore Facilities, User's Guide,* UG-2029-ENV (May 1998).

(3) BUMEDINST 5450.157 Series, *Missions, Functions, and Tasks of Navy Environmental Health Center and its Subordinate Commands.*

(4) BUMEDINST 6240.10 Series, *Standards for Potable Water*.

(5) Type Command Medical Guides, 6000.1 Series.

(6) Naval Ships Technical Manual, Chapter 074, Vol. 3, *Gas Free Engineering*.

(7) Naval Ships Technical Manual, Chapter 090*, Inspections, Tests, Records, and Reports.*

(8) Naval Ships Technical Manual, Chapter 220, Vol. 1, *Water Chemistry* - Vol. 2, *Test and Treatment.*

(9) Naval Ships Technical Manual, Chapter 505, *Piping Systems*.

(10) Naval Ships Technical Manual, Chapter 531, *Desalination,* Vol. 1, *Low-pressure Distilling Plants.*

(11) Naval Ships Technical Manual, Chapter 51, *Desalination,* Vol. 2, *Vapor Compression Distilling Plants.*

(12) Naval Ships Technical Manual Chapter 531, *Desalination,* Vol. 3, *Reverse Osmosis Desalination Plants.*

(13) Naval Ships Technical Manual, Chapter 533, *Potable Water Systems*.

(14) Naval Ships Technical Manual, Chapter 631, *Preservation of Ships in Service*.

(15) Naval Ships Technical Manual, Chapter 670, *Stowage, Handling, and Disposal of Hazardous General Use Consumables.*

(16) NAVSUP Publication 486, Vol.1, *Food Service Management*.

(17) QSTAG 245, Edition 2, American-British-Canadian-Australian Quadripartite Standardization, *Minimum Requirements for Water Potability (Short and Long Term Use).*

(18) NATO Standardization Agreement: STANAG 2136, *Minimum Standards of Water Potability in Emergency Situations.*

(19) NATO Standardization agreement: STANAG 2885, *Emergency Supply of Water in War.*

(20) USACHPPM Technical Guide 230, "Chemical Exposure Guidelines for Deployed Military Personnel."

(21) U.S. Public Health Service, Food and Drug Administration Publication, *Acceptable Vessel Watering Points Interstate Conveyance Official Classification List.*

(22) U.S. Environmental Protection Agency, EPA 570/9-89-007, *Cross-Connection Control Manual.*

(23) Standard Methods for the Examination of Water and Waste Water, Current Edition, by APHA, AWWA, and WPCF.

(24) Department of Defense, *Overseas Environmental Baseline Guidance Document* (OEBGD), current edition.

(25) Handbook of Chlorination and Alternative Disinfectants. G.C. White. 4th Edition.

(26) National Sanitation Foundation International, NSF/ANSI Standard 60: *Drinking Water Treatment Chemicals - Health Effects.*

(27) National Sanitation Foundation International, NSF/ANSI Standard 61: *Drinking Water System Components - Health Effects.*

(28) American Water Works Association Standard, ANSI/AWWA C652-02: *Disinfection of Water-Storage Facilities.*

6-57. Appendices

a. **Appendix A – Abbreviations**

(1) ANSI	American National Standards Institute
(2) APHA	American Public Health Association
(3) AWWA	American Water Works Association
(4) BUMED	Bureau of Medicine and Surgery
(5) CT	Contact Time
(6) DON	Department of the Navy
(7) DST	Defined Substrate Technology
(8) EDG	Electrolytic Disinfectant Generator
(9) EPA	Environmental Protection Agency
(10) FAC	Free Available Chlorine
(11) FDA	Food and Drug Administration
(12) HPC	Heterotropic Plate Count
(13) HTH	Calcium Hypochlorite
(14) ISEA	In-Service Engineering Agent
(15) MCL	Maximum Contaminant Level
(16) MDR	Medical Department Representative
(17) MRC	Maintenance Requirement Card
(18) MSC	Military Sealift Command
(19) MSD	Marine Sanitation Devices
(20) mg/L	Milligrams per Liter (same as ppm for water)
(21) NAVENPVNTMEDUs	Naval Environmental Preventive Medicine Units
(22) NAVFACENGCOM	Naval Facilities Engineering Command
(23) NAVSEACEN	Naval Sea Support Center
(24) NAVSEASYSCOM	Naval Sea Systems Command
(25) NSF	National Sanitation Foundation International
(26) NSTM	Naval Ships Technical Manual
(27) OPNAV	Office of the Chief of Naval Operations
(28) PMA	Preventive Medicine Authority
(29) POE	Point of Entry
(30) POU	Point of Use
(31) PPM	Parts Per Million (same as mg/L for water)
(32) RO	Reverse Osmosis
(33) SAMS	Shipboard Automated Medical System
(34) SDWA	Safe Drinking Water Act
(35) TBR	Total Bromine Residual
(36) TCR	Total Coliform Rule
(37) TDS	Total Dissolved Solids
(38) TOC	Total Organic Carbon
(39) VOCs	Volatile Organic Chemicals
(40) WPCF	Water Pollution Control Federation

b. **Appendix B – Definitions**

(1) **Coaming.** A raised frame (as around a hatchway in the deck of a ship) to keep out water.

(2) **Distillation.** The total process the distilling plant forms, including evaporation and condensations.

(3) **Free Available Chlorine (FAC).** Chlorine available (after demand is met) in the forms of Hypochlorous acid and Hypochlorite ions.

(4) **Micron.** A unit of length. One millionth of a meter or one thousandth of a millimeter. One micron equals 0.00004 of an inch.

(5) **Point of Use (POU).** A treatment device applied to a single tap used for the purpose of reducing contaminants in drinking water at that one tap.

(6) **Potable Water.** Water that is suitable for human consumption, bathing, laundry, personal hygiene.

(7) **Reverse Osmosis (RO).** The reverse of the natural osmosis achieved by external application of sufficient reverse pressure to cause the solvent to flow in its unnatural direction.

(8) **Colilert ®.** Uses the patented Defined Substrate Technology® (DST®) to simultaneously detect total coliforms and *E. coli*. Two nutrient-indicators, ONPG and MUG, are the major sources of carbon in Colilert and can be metabolized by the coliform enzyme *ß*-galactosidase and the *E. coli* enzyme *ß*-glucuronidase, respectively.

(9) **Colisure ®**. Uses Defined Substrate Technology® (DST®) nutrient indicators CPRG and MUG to detect total coliforms and *E.coli*. Coliforms use their *ß*-galactosidase enzyme to metabolize CPRG and change it from yellow to magenta. *E.coli* use ß-glucuronidase to metabolize MUG and create fluorescence.

(10) **Total Coliform.** Are a group of closely related, mostly harmless bacteria that live in soil and water as well as the gut of animals. The extent to which total coliforms are present in the source water can indicate the general quality of that water and the likelihood that the water is fecally contaminated. The presence or absence of total coliform bacteria is the drinking water standard.

(11) ***E. Coli.*** Is a type of fecal coliform bacteria commonly found in the intestines of animals and humans. *E. coli* is short for *Escherichia coli*. The presence of *E. coli* in water is a strong indication of recent sewage or animal waste contamination. Sewage may contain many types of disease-causing organisms.

(12) **Heterotrophic Plate Count (HPC)** (microbiological) (35^{o} C, 48 hours) in drinking water should not exceed 500 colonies per ml. The HPC is a microbiological test used to determine the quality of the water in terms of its general bacterial content. This test is used as a supplement to the routine analysis for coliform bacteria. HPCs can also be used to monitor disinfection efficiency at water treatment plants and as a measure of water quality deterioration in distribution lines (e.g., biofilm formation) and reservoirs.

c. **Appendix C – Water Sampling Technique**

Collecting a Halogen Sample	Collecting a Bacteriological Sample
Open tap fully and let water run for 2-3 minutes or for a time sufficient to permit clearing the service line.	Use aseptic technique to collect the sample in approved bottles or whirl packs. Do not rinse bottle prior to collection.
Collect the sample and add the appropriate DPD tablet (dependant on halogen type)	Label the sample for identification, including sampling site and time of sampling in the potable water log.
Take the reading within the first 30 seconds of adding the DPD tablet. The sampling tube should be read uncovered and at eye level.	Prepare the sample in accordance with Appendix D or E, as appropriate.
Determine the halogen level and record findings in potable water log.	Incubate the sample as prescribed. Record results in potable water log.

d. **Appendix D - Sample Potable Water Sanitation Bill**

(1) **Responsibility**

(a) The engineering department of the ship is responsible to the commanding officer/master for implementing the requirements of the Naval Sea Systems Command. This responsibility includes the operation and maintenance of the shipboard water supply system, production of an adequate amount of water, and disinfection.

(b) The Medical Department is responsible for conducting a comprehensive medical surveillance program of the potable water system including adequacy of disinfecting procedures, collection of samples for bacteriological analysis, and daily halogen residuals from the distribution system. The Medical Department shall notify the commanding officer/master of any discrepancies observed in the potable water distribution system.

(2) **Sources**

(a) **Processing of Seawater.** Distillation or RO processing of seawater from harbors or polluted seawater is to be avoided except in emergencies. Seawater must be assumed polluted when ships are operating in close formation. While making potable water, care must be taken not to strip fuel waste tanks or empty bilges forwarded of the salt-water intakes. Naval Ships Technical Manual, Chapter 533, provides additional details.

(b) **Potable Water.** Potable water may be received from approved shore facilities or other ships. The following is a list of approved sources for potable water:

1. EPA-approved public water systems.

2. Approved U.S. military sources including water utility establishments under the cognizance of the British Royal Navy, Canadian Forces, and the Royal Australian Navy. These sources are subject to termination or modification. See the current American-British-Canadian-Australian Naval Quadripartite Standardization Agreement Program, ABCA NAVSTAG 23, Quality Standards for Potable Water. Under certain emergency or wartime situations, shore water sources may be under the cognizance of Quadripartite Standardization Agreement 245, Edition 2, of the American-British-Canadian-Australian Armies

Standardization Program, Minimum Requirements for Water Potability (Short and Long Term Use) or the NATO Standardization Agreement, STANAG 2136, Minimum Requirements of Water Potability for Short Term Issue (STANAG 2136 is under revision and the new title will probably be, Minimum Standards of Water Potability in Emergency Situation).

3. Other extra-continental source data may be obtained from U.S. military representatives ashore or NAVENPVNTMEDUs having area responsibility. It is advisable that the Medical Department attempt to obtain this information prior to departure from CONUS.

(3) **Procedures for Ship-to-Shore and Ship-to-Ship Connections**

(a) All shore connections should be made or supervised by trained shore based personnel when available; however in many instances ship personnel must assume this responsibility. Personnel trained in the handling of potable water shall also accomplish ship-to-ship transfer of potable water.

(b) Potable water hoses should be furnished by shore establishments; hoses are normally provided by the supplying ship if the transfer is at sea.

(c) MDR must ensure that an adequate halogen residual is present in the water prior to the initial transfer of water.

(d) The potable water outlet must be flushed for 15-30 seconds and disinfected with a solution of 100-ppm FAC. Let stand for 2 minutes and reflush.

(e) The hose must be flushed for 15-30 seconds prior to connecting to the ship.

(f) Ship risers for potable water must be conspicuously designated by a warning plate with the inscription "POTABLE WATER ONLY" in 1-inch letters. The connection shall be no less than 18 inches above the deck and covered with a screw cap attached by a keeper chain when not in use.

(g) The individual making the hook-up must ensure the intake hose is not connected to a non-potable system aboard ship.

(h) The hose must not at any time be submerged in the harbor water.

(i) The above precautions and procedures must be followed when making ship-to-ship potable water hose connections.

(4) **Potable Water Hoses**

(a) Potable water hoses must be marked "POTABLE WATER ONLY" approximately every 10 feet and must be used for potable water only. Transfer of potable water will be accomplished through disinfected hoses. Hoses are disinfected by filling for 2 minutes with 100 ppm FAC solution. After disinfection, hose ends must be coupled or capped and stored in lockers at least 18 inches above the deck and protected from weather dust, and vermin.

(5) **Storage Tanks.** Potable water tanks should not be filled with ballast water unless absolutely necessary for the survival of the ship. When non-potable water is introduced into potable water tanks, all tanks, lines, fittings, and pumps must be disconnected from the potable water system plugged or capped and not reconnected until adequately cleaned, flushed, disinfected, and tested.

(6) **Disinfection**

(a) **Only the following halogens may be used for disinfecting potable water**

1. Calcium Hypochlorite (technical 65/70% HTH), NSN 6810-00-255-0471, 6-ounce jar.

2. Sodium Hypochlorite (unscented), NSN 6810-00-598-7316, 1 gallon bottle (5%); NSN 6810-00-900-6276, 5 gallon pail (5%).

3. Bromine Cartridges, NSN 4610-01-022-9970.

(b) **Calcium Hypochlorite.** Automatic/mechanical disinfection is preferred. For batch chlorination prescribed chemical dosage to obtain the required residual will be mixed with warm water in a container and allowed to settle. Introduce only the clear fluid (supernatant) into the tank when it is one-fourth full. Under no circumstances is this solution introduced into the tank by using brominating equipment. If chlorine solution is added to a full tank, the water must be recirculated to ensure adequate mixing. If the required level of chlorine is not present after a 30-minute contact period at the tank then additional chemical must be added.

(c) **Sodium Hypochlorite.** Enough chemical solution is added directly to the tank when it is one-fourth full to obtain the required residual. No prior mixing or dilution is required.

(d) **Hypochlorinators.** Refer to manufacturer's operational instructions and requirements.

(e) **Brominators.** Bromination of a potable water system requires two types of brominators. One type is used in the distillate discharge line and the other is used to treat water in the tank while recirculating potable water.

(7) **Halogen Residual and Bacteriological Testing**

Routine Testing Procedure Summary

TESTING	PERSONNEL < 400 CREW	PERSONNEL 400-800 CREW	PERSONNEL > 800 CREW
Halogen Residual (FAC/TBR)	4 Tests Daily	8 Tests Daily	12 Tests Daily
Bacteriological (Potable Water Tanks)	1/4 of Total Number of Potable Water Tanks Weekly		
Bacteriological (Distribution System)	4 Tests Weekly	8 Tests Weekly	12 Tests Weekly
Bacteriological (Ice)	1/4 of Total Number of Ice Machines Weekly		
Emergency Potable Water Tanks	1 Bacteriological Sample Per Tank Monthly		

(a) The MDR must check the disinfectant residual in the distribution system daily to determine that halogen residual is maintained. Tests will be formed at random locations to ensure adequate coverage of the entire system. The number of samples required will be determined by crew number onboard the ship; no less than four samples will be collected.

(b) A DPD chlorine-bromine-pH combination test kit or digital chlorine analyzer is required for forming halogen residual determinations.

(c) Results of halogen residuals will be recorded in the water log. Continual absence of halogen levels must be reported to the commanding officer with a copy to the engineering officer.

(8) **Bacteriological Testing**

(a) The Medical Department will ensure that bacteriological water samples are collected and tested weekly. Samples will be collected at representative points throughout the distribution system as well as from potable water tanks and ice machines. This includes potable water in storage tanks while the ship is in port and the system is receiving direct service from shore potable water pipes. Special or more frequent tests are required whenever chlorine demand increases; contamination is suspected, after cleaning and disinfection of potable water tanks and upon completion of repairs to the system.

(b) When the results of a sample are total coliform-positive, a set of repeat samples for each total coliforms-positive sample must be taken and analyzed for total coliforms. At least one repeat sample must be from the same tap as the original positive sample. Two other repeat samples must be collected from within five service connections of the original positive sample. One sample must be taken upstream and the other downstream. If the original positive sample is at the end of the distribution system, two samples will be collected upstream. If total coliforms are absent in these samples, the water is safe to use.

(c) A report of the bacteriological examinations will be submitted to the commanding and engineering officers and the results entered in the potable water log.

(9) **Temperature, pH, and Salinity.** These tests are be conducted at least daily by the engineering department. Variations in temperature, pH, and salinity may affect the water treatment procedure.

(10) **Disinfection of Tanks and Distribution System.** When mechanical cleaning and chemical disinfection are required the potable water tank will be disinfected. When indicated the potable water distribution system will be disinfected as well. Follow one of the three methods of disinfection below.

Methods For Disinfection Of Potable Water Tanks Per ANSI/AWWA Standard C652-02*

METHOD 1	METHOD 2	METHOD 3
Fill tank to over flow level	Spray/apply directly 200 ppm FAC to all tank surfaces	Fill 5% of tank volume with 50 ppm FAC solution
Add chlorine to achieve 10 ppm FAC throughout the tank	Flush inlet/outlet pipes with 10 ppm FAC	Hold solution for 6 hours
Hold this solution for 24 hours	Disinfected surfaces shall remain in contact with chlorine solution for a minimum of 30 minutes	Add potable water to chlorine solution to fill tank; hold this water for 24 hours
Drain tank	Refill tank with potable water with required halogen residual level	Drain tank
Refill tank with potable water with required halogen residual level		Refill tank with potable water with required halogen residual level
Perform bacteriological testing of potable water.		
Upon satisfactory bacteriological testing and asthetic quality water may be delivered to the system.		

*Table reads from top to bottom, not left to right

Highly chlorinated water discharges shall comply with Federal, State, local, or host nation environmental regulations. Special provisions or permits may be required prior to discharge of highly chlorinated water. The proper authorities shall be contacted prior to disposal of highly chlorinated water. American Water Works Association Standard *ANSI/AWWA C652-02 Appendix B* provides guidance for neutralizing highly chlorinated water.

(11) **Distribution System**

(a) Potable water piping must not be used for any purpose other than potable water.

(b) The potable water distribution system must not be cross-connected to any possible source of contamination.

(c) Potable water to be used as boiler feed water must be supplied through an air gap.

(d) Potable water piping must not pass through non-potable liquid storage tanks and non-potable liquid pipes must not pass through potable water tanks unless the pipes are surrounded by a sloping, self-draining pipe tunnel.

(e) Potable water piping must be labeled as to the type of service with an arrow indicating the direction of flow.

(f) If any break occurs in the potable water system, accidental or otherwise, the parts concerned must be disinfected after reassembly and prior to placing that part of the system back in service. The MDR must be notified concerning any break in the water distribution system.

(g) Potable water pumps must not be primed with other than potable water.

(h) Potable water must be used in the manufacture of all ice.

(12) **Records**

(a) The engineering department should maintain adequate records to furnish documentary evidence of engineering responsibilities concerning production, treatment, and distribution of potable water.

(b) The MDR will maintain a potable water log; the entries must be a 2-year chronological record of potable water surveillance. Entries are made in chronological order and must contain the following:

1. Each time a water sample is taken, record the time and date, the location of the ship, location of the sampling site, the source of the ship's water, and whether or not from an approved source.

2. Results of halogen residual test (state type of halogen) and reason taken, e.g., daily, in connection with bacteriological analysis, prior to receipt or in connection with disinfection of tanks or lines. Include any follow-up action taken when negative readings are obtained.

3. Results of all bacteriological analysis including controls. State reason test performed such as weekly, special, or in connection with disinfection of tanks or lines. Record action taken in the case of positive samples, even if the tests were performed by another activity.

4. Record any repairs or modification to the potable water system or tanks, any problems with taste or odor and their resolution, the findings of inspections and surveys and any action taken.

(13) The MDR must make frequent inspections of the potable water procedures and system to ensure that the provisions of this bill are being carried out. Any discrepancies must be reported in writing to the commanding officer as applicable with a copy to the engineering officer.

Bureau of
Medicine and Surgery
Washington, D.C. 20372-5300

NAVMED P010-7 (Rev. 1995)
0510-LP-209-9600

Manual of Naval Preventive Medicine

Chapter 7

WASTEWATER TREATMENT AND DISPOSAL, ASHORE AND AFLOAT

DISTRIBUTION STATEMENT "A"

0 5 1 0 L P 2 0 9 9 6 0 0

CONTENTS

Chapter 7

WASTEWATER TREATMENT AND DISPOSAL, ASHORE AND AFLOAT

Section 1. General

2-1. Scope.

This chapter describes the methods used in wastewater treatment and/or disposal at Naval activities ashore and afloat and prescribes procedures relevant to the prevention of communicable disease associated with human wastes in the operation and maintenance of these wastewater systems. This chapter is not intended as a technical guide for treatment plant operation.

7-2. Definitions

1. *Aerobic Waste Treatment.* The stabilization of wastes through the action of microorganisms in the presence of oxygen.

2. *Anaerobic Waste Treatment.* Waste stabilization brought about through the action of microorganisms in the absence of air or elemental oxygen.

3. *Black Water.* Human body wastes and wastes from toilets, urinals, soil drains, and receptacles intended to receive or retain body wastes. Also referred to as sewage.

4. *Comminutor.* A comminutor is a motor-driven grinder used to pulp or liquify sewage solids before they enter the Marine Sanitation Device (MSD).

5. *Contiguous Zone.* A zone of the high seas, established by the U.S. under the *Convention of the Territorial Sea and the Contiguous Zone,* which is contiguous to the territorial sea which extends nine nautical miles (nm) seaward from the outer limit of the territorial sea.

6. *Cross Connection. Any* actual or potential connection between the potable water supply and a source of contamination or pollution.

7. *Effluent.* Wastewater or other liquid partially or completely treated or in its natural state flowing out of a reservoir, basin, sewage treatment plant, industrial plant or marine sanitation device.

8. *EPA.* The abbreviation for the Environmental Protection Agency.

9. *Facultative Anaerobic Bacteria.* Bacteria which can adapt to grow in the presence of, as well as the absence of, oxygen.

10. *Gray Water.* Refers to ship generated wastewater which originates from culinary activities, bathing, laundry facilities, deck drains, and other waste drains.

11. *Inland Waters.* Inland waters are generally navigable fresh or brackish waters upstream from coastal territorial waters.

12. *Marine Sanitation Device (MSD). Any* equipment on board a ship or craft which is designed to receive and treat sewage to a level acceptable for overboard discharge; or which receives and retains sewage on board for later discharge ashore; or in waters

where discharge is permissible. Within the generic term "MSD," the Navy uses the following terms to identify the general types:

a. Type I. "Flow-through" and "Discharge" device designed to receive and treat sewage aboard ship and produce an overboard effluent with a fecal coliform count of not more than 1,000 per 100 milliliters and no visible solids.

b. Type II. "Flow-through" and "discharge" device that produces an overboard effluent with a fecal coliform count of not more than 200 per 100 milliliters and total suspended solids of not more than 150 milligrams per liter. The Pall Trinity Biological Waste Treatment System is an example of a Type II MSD.

c. Type III-A. "Nonflow-through" device designed to collect shipboard sewage by means of vacuum or other reduced-flush systems and hold the sewage while transiting navigable waters. This type may include equipment for shipboard evaporation or incineration of collected sewage. Examples include the GATX Evaporative Toilet System, The Jered Vacu-Burn Treatment System and the Koehler-Dayton Recirculating Flush System.

d. Type III-B. Collection, holding, and transfer (CHT) system designed to collect both sewage and gray water while in port; to offload sewage and gray water to suitable shore receiving facilities; to hold sewage while transiting navigable waters; and to discharge overboard both sewage and gray water while operating beyond navigable waters. The CHT system consists of collection and discharge piping, pumps, comminutors (or strainers) an aeration system and holding tanks.

13. *Navigable Waters of the United States.* The coastal territorial waters (sea) of the United States, the inland waters of the United States, including the United States portion of the Great Lakes, the St. Lawrence Seaway, and the Panama Canal

14. *Restricted Zone.* The navigable waters of the United States, O to 3 nm from shore.

15. *Sewage.* Sewage when referred to in shipboard application, is defined as wastes of human origin from water closets and urinals and transported by the ship's soil drain system. Sewage is also referred to as backwater. When referred to in shore-based treatment applications, the term "sewage" may include a combination of backwater and other wastewater.

16. *Soil Drains.* Drains which collect sewage from toilets and urinals.

17. *Territorial Sea.* The belt of the seas measured from the line of ordinary low water along that portion of the coast which is in direct contact with the open sea, and the line marking the seaward limit of inland waters and extending seaward a distance of 3 nm.

18. *Wastewater*. The spent water of a ship, base, industrial plant or other activity. From the standpoint of source, it may be a combination of the liquid and water carried wastes from soil and waste drains of ships, industrial plants, housing areas, and institutions-together with any groundwater, surface water, or storm water that may be present.

19. Waste *Drains.* Drains which collect wastewater (gray water) from showers, laundries and galleys, etc.

7-3. National Effluent Guidelines.

The *Federal Water Pollution Control Act Amendments* of 1972 (PL92-500) established the National Pollutant Discharge Elimination System (NPDES) which is a program to control water pollution in the nation's waterways by limiting the discharge of polluted effluents into the navigable waters from point sources. Each industrial, agricultural, and municipal wastewater discharger is required to obtain a discharge permit from the Environmental Protection Agency (EPA) or state regulatory agency, which sets an effluent limitation for that activity based on the national effluent limitation guidelines published by the EPA. Under this system, the discharger is required to monitor its own discharges of pollutants and submit periodic reports to the control agency. If the discharger cannot comply immediately with established limitations, the permit includes a schedule which sets forth specific dates when the required reduction of pollutants must be achieved. Non-compliance with NPDES permits carries a maximum penalty of $50,000 per day and two years in prison. Information regarding the effluent guidelines are published in 40 Code *of Federal Regulations,* Parts 100-149 (40 CFR 100-149). This document is available through the Government Printing Office, Washington, DC 20402.

7-4. Policy

1. The above legislation and *Executive Order 12088* requires federal agencies to conform to federal, state, and local pollution control regulations and provide leadership in the protection and enhancement of the quality of air, water, and land resources. Installation, operation, and maintenance of shipboard pollution control equipment and systems is mandatory. Shipboard personnel must use existing pollution control equipment and procedures to prevent pollution of the seas and coastal areas. This will effectively protect and enhance the water quality of these areas and prevent possible litigation against the Navy.

2. OPNAVINST 5090.1 Series, The Environmental Natural Resources Protection Manual, promulgates Navy policy and assigns responsibilities for Navy-wide actions for prevention, control, and abatement of environmental pollution caused by Naval ships and facilities. The following policy is included in this instruction.

a. The Navy will actively participate in a program to protect and enhance the quality of the environment through strict adherence to all applicable regulatory standards, positive planning and programming actions to control pollution caused by Navy facilities, and establishment of methods to monitor the effectiveness and compliance of such actions.

b. *Executive Order 12088,* requires Navy shore facilities and forces afloat, as appropriate, to corporate with federal, state and local environmental protection organizations and comply with the official substantive standards and criteria promulgated by such agencies. The *Clean Water Act of 1977,* PL 95-217, requires Naval facilities to comply with state or local administrative procedures for pollution abatement and control. Where, in the interest of national defense or other relevant reasons, it is considered impractical to comply with standards and criteria, the matter must be referred to the Chief of Naval Operations, via the chain of command, for resolution.

c. Naval installations overseas must cooperate with foreign host nations and communities and, to the extent practicable, provide pollution abatement measures equal in degree and timing to those of host nations. Navy ships in foreign harbors and units overseas must conform to environmental quality standards set forth in applicable international, bilateral, and Status of Forces Agreements to which the U.S. Government is a party.

7-5. Responsibilities

1. The Chief of Naval Operations promulgates Navy Policy and assigns responsibilities concerning prevention, control, and abatement of environmental pollution caused by Naval ships and shore stations. See

OPNAVINST 5090.1 Series and Naval Ship's Technical Manual (NSTM), Chapter 593, Pollution Control.

2. The Commander, Naval Facilities Engineering Command (NAVFACENGCOM) through the Naval Facilities Engineering Field Divisions (EFDs) provides technical assistance on compliance with the permit system to area coordinators and Naval activities. EFDs also serve as the principal contact point between Naval commands and EPA regional offices, in obtaining permit application formats and forwarding completed applications.

3. The Chief, Bureau of Medicine and Surgery (BUMED), through the Occupational Health and Preventive Medicine Services at Naval hospitals, Navy Environmental Health Center, and Navy Environmental and Preventive Medicine Units, is responsible for evaluation of wastewater disposal systems ashore and afloat as they relate to potentially hazardous conditions which could adversely affect the health of Navy military and civilian personnel.

4. Local commanders are responsible for obtaining a discharge permit and ensuring that the operation of wastewater treatment facilities and quality of all applicable effluents discharged into navigable waters are in compliance with the permit.

7-6. Navy Discharge Permit Requirements.

Discharge permits are required for all Naval activities that discharge domestic or industrial wastes into navigable waters and/or the waters of the contiguous zone or the oceans. Navy shore facilities which discharge into publicly-owned treatment works or non-Navy-owned sewage systems require permits to provide pretreatment of industrial wastes. Ships, boats, and yard craft, storm sewer outlets which do not receive polluted effluents; and injection wells or agriculture projects are exempt from discharge permit requirements. Permit applications are completed by EFDs for submittal to EPA or the state as appropriate. Applications must be filed 180 days prior to the date the discharge is to begin. Most permits are valid for 5 years and reapplication is required 180 days in advance of the expiration date.

OPNAVINST 5090.1 Series and Naval Ship's Technical Manual (NSTM), Chapter 593, Pollution Control.

2. The Commander, Naval Facilities Engineering Command (NAVFACENGCOM) through the Naval Facilities Engineering Field Divisions (EFDs) provides technical assistance on compliance with the permit system to area coordinators and Naval activities. EFDs also serve as the principal contact point between Naval commands and EPA regional offices, in obtaining permit application formats and forwarding completed applications.

3. The Chief, Bureau of Medicine and Surgery (BUMED), through the Occupational Health and Preventive Medicine Services at Naval hospitals, Navy Environmental Health Center, and Navy Environmental and Preventive Medicine Units, is responsible for evaluation of wastewater disposal systems ashore and afloat as they relate to potentially hazardous conditions which could adversely affect the health of Navy military and civilian personnel.

4. Local commanders are responsible for obtaining a discharge permit and ensuring that the operation of wastewater treatment facilities and quality of all applicable effluents discharged into navigable waters are in compliance with the permit.

7-6. Navy Discharge Permit Requirements.

Discharge permits are required for all Naval activities that discharge domestic or industrial wastes into navigable waters and/or the waters of the contiguous zone or the oceans. Navy shore facilities which discharge into publicly-owned treatment works or non-Navy-owned sewage systems require permits to provide pretreatment of industrial wastes. Ships, boats, and yard craft, storm sewer outlets which do not receive polluted effluents; and injection wells or agriculture projects are exempt from discharge permit requirements. Permit applications are completed by EFDs for submittal to EPA or the state as appropriate. Applications must be filed 180 days prior to the date the discharge is to begin. Most permits are valid for 5 years and reapplication is required 180 days in advance of the expiration date.

SECTION II. WASTEWATER TREATMENT AND DISPOSAL SYSTEMS ASHORE

Article

7-7. Introduction

1. Sewage may be treated by a wide variety of methods using simple settling techniques or sophisticated engineering systems. Cesspools, septic tanks, and Imhoff tanks are all examples of simple self-contained systems used for wastewater treatment. More advanced systems are defined by the level of sewage treatment they provide.

These methods are referred to as:

a. Primary treatment (with or without chemicals)

b. Secondary treatment (biological treatment)

c. Tertiary Treatment (advanced wastewater treatment)

2. Primary treatment consists of methods designed to remove a considerable portion of the suspended solids and colloidal substances. Primary treatment is used for the removal of floating and suspended solids, neutralization, and equalization, and to prepare the wastewater for subsequent. treatment or discharge.

3. Secondary treatment oxidizes the suspended solids and the organic solids in solution that remain after primary treatment. The principle methods of secondary treatment are activated sludge and trickling filters. Stabilization ponds are another method of secondary treatment, often used where large land areas are available and a high quality effluent is not required at all times.

4. Tertiary treatment or advanced wastewater treatment is defined as treatment of wastewater for the removal of pollutants not removed by conventional biological treatment processes (activated sludge, trickling filters, oxidation ponds, etc.). These pollutants include suspended solids, Biological Oxygen Demand (BOD), refractory organics (reported as Total Organic Carbon or Chemical Oxygen Demand), nutrients (nitrogen and phosphorus), and inorganic salts. Advanced wastewater treatment is also associated with the term “water reclamation,” which is a system that employs a combination of conventional and tertiary treatment processes that returns the wastewater to its original quality.

7-8. Individual Sewage Disposal Systems

1. Pit Privy. The pit privy is the most primitive of all the individual sewage disposal systems. This type of system is no longer authorized at Naval activities (except in field conditions such as bivouacs). It consists of a hole in the ground with the toilet seat located directly over it. A variation of the pit privy is the bored-hole latrine which is a hole 10-25 inches in diameter and 15-25 feet deep. A concrete slab is usually placed over the hole. The location of a privy is critical. Whenever possible, it should be located down-slope from a well. In some special cases, however, where the soil is uniformly compact and the ground water does not enter the pit, or the pit itself does not penetrate the water table, a privy may be constructed up-slope from a well. When this is done, the privy must be at least 100 feet from the well, particularly if there is the possibility that the water table may rise into the privy during a period of heavy rain. If the water table is permanently within a few feet of the ground surface, conditions are not favorable for a pit privy. Other variations on the pit privy include the vault toilet and chemical toilet. A vault toilet consists of a water-tight concrete vault over which a toilet seat is placed. It is used where soil conditions do not favor a pit privy. Vault toilets must be periodically emptied and are not an efficient waste disposal method. A chemical toilet consists of a tank with a capacity of about 45 gallons per seat. The operation of this system depends on the action of a caustic disinfectant and water. The solution is used to kill the bacteria and liquify the solids. As with the vault toilet, this system must be periodically emptied. In addition, the system must be recharged with the full amount of chemical. All of these systems are subject to the problems of odor production and insect breeding when not properly maintained.

2. *Cesspools.* A cesspool (Figure 7-1) is simply a covered pit into which raw sewage is emptied. Unlike the pit privy, it is designed to function with a water carriage system. The cesspool is the reverse of a well. The sides are usually lined with brick or stone masonry, and the joints laid without mortar so that the sewage can leach out. Liquids leach into the soil and solids remain in the pit where they decompose. Household wastes containing grease, oil, soaps, and other insoluble substances are deposited on the walls and bottom of the cesspool impeding the leaching process. Soon the system becomes a septic tank. Because there are no provisions for the subsurface distribution of the liquid effluent, cesspools often overflow, discharging onto the ground surface. To prevent this, cesspools must be cleaned frequently.

3. *Septic tanks.* A septic tank (Figure 7-2) is a watertight tank placed underground into which raw sewage flows by gravity. Sewage is discharged into the tank where a series of baffles are placed to slow the flow, allowing the solids to settle and be retained. During this retention period, 50 to 70 percent of the suspended solids are removed. The solids are then reduced in volume by the biological action of anaerobic and facultative bacteria. This process is known as digestion and during the process most pathogenic organisms are destroyed; however, the liquid effluent may still contain some pathogenic organisms and is still putrescible. The septic tank discharges through an opening near the top placed at the end opposite the influent. The effluent is disposed of using a network of concrete or clay pipe laid with open joints, or perforated PVC pipe which permits wastewater to percolate into and through the soil. Filtration by the soil removes more of the suspended matter and aerobic bacteria stabilize" the organic matter remaining in the effluent. It is important that leach fields be naturally drained, permeable, and of sufficient area. Areas with heavy clay soils and limestone formations are not acceptable for leach fields.

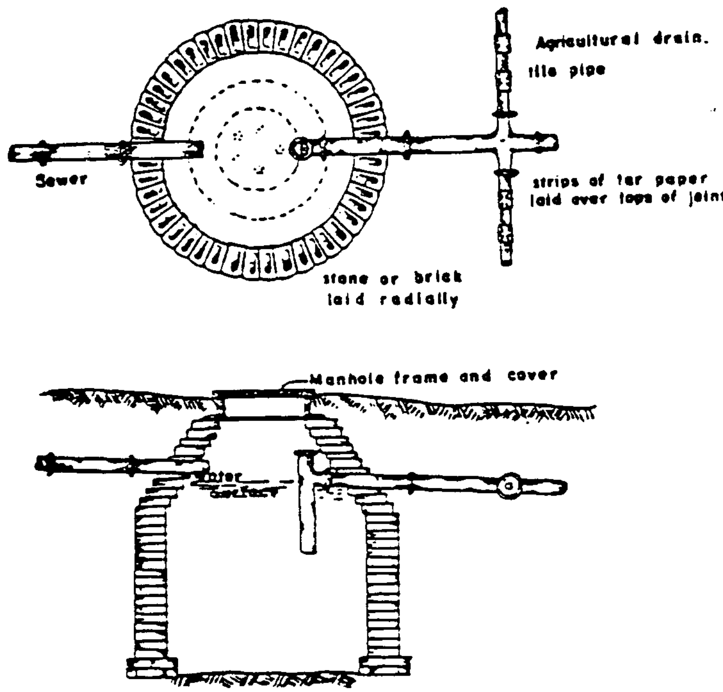


Figure 7-1. Leaching cesspool
(Rarely used)

4. *Imhoff tanks.* The Imhoff tank (Figure 7-3) obtained its name from its inventor, Dr. Karl Imhoff of Germany. It is a variation of the septic tank in which two chambers are provided, one above the other. The upper sedimentation or flow chamber is for settling solids and the lower chamber is for anaerobic digestion of sludge. Solids settle to the bot-

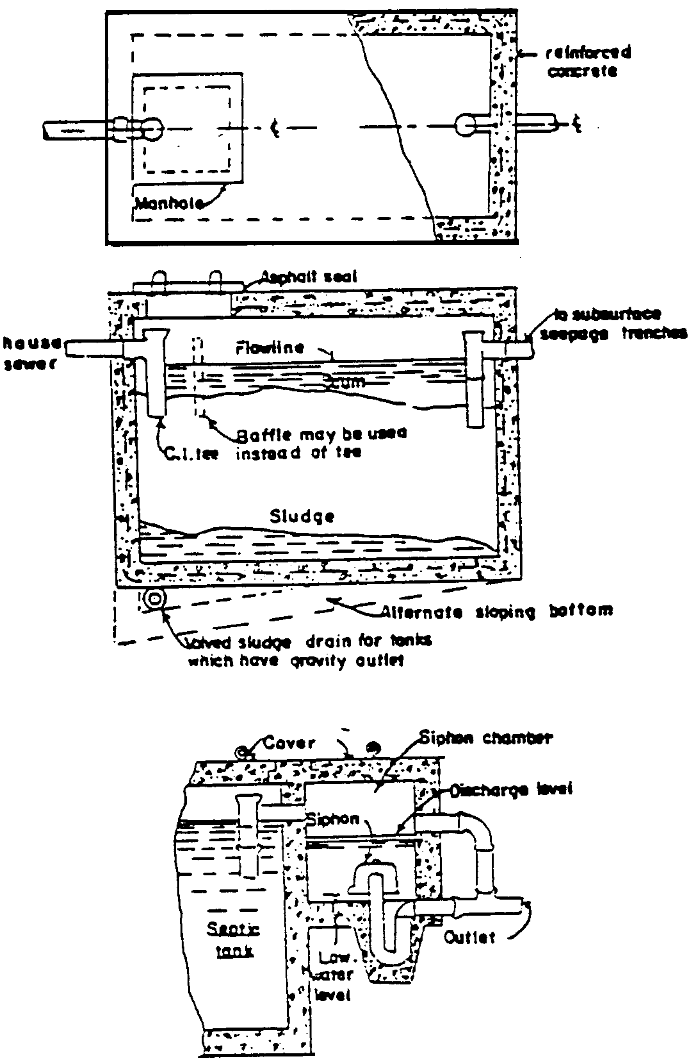


Figure 7-2. Typical septic tank

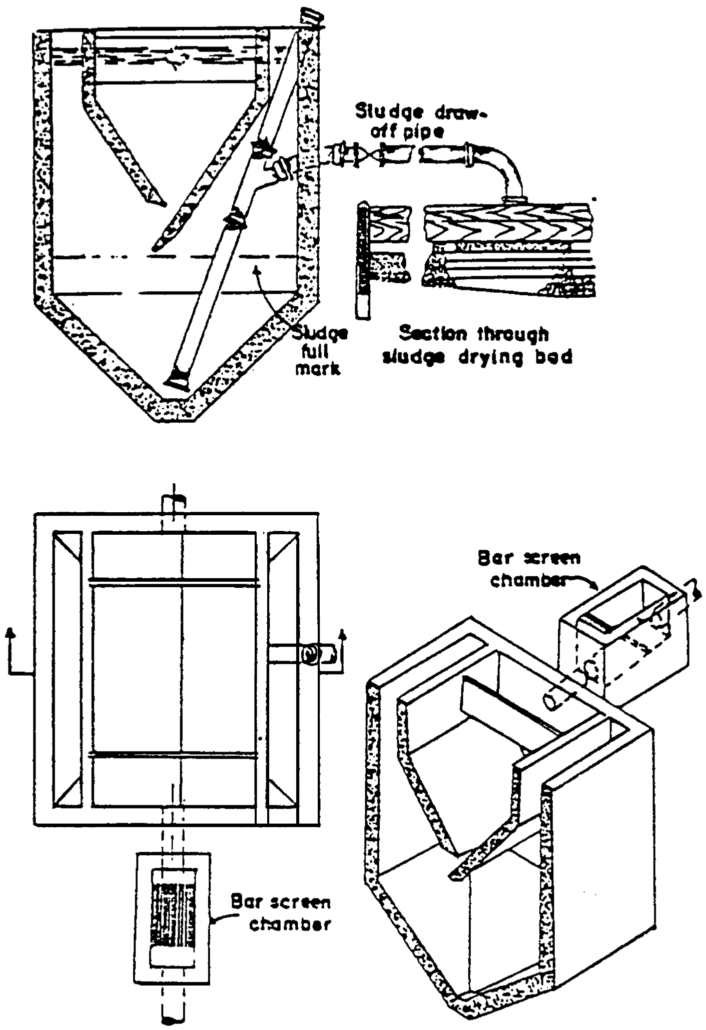


Figure 7-3. Typical Imhoff Tank

tom of the flow chamber passing through a slot at the bottom into the lower chamber. The slot is baffled in such a manner that gas rising from the lower chamber does not interfere with the sedimentation process in the upper chamber. A gas vent, known as the scum chamber, extends from the lower compartment up to the tank surface between the outside wall of the sedimentation chamber and the Imhoff tank enclosing wall. The main advantage of this type of tank over the septic tank is that sludge is separated from the effluent, which allows for more complete settling and digestion. Operated properly, these systems are capable of removing 30 to 60 percent of the suspended matter, and from 25 to 40 percent of the BOD.

5. *Other Non-Sewered Waste Disposal Systems.* This category of waste disposal systems includes various portable or temporary toilets such as chemical toilets, combustion toilets, vaulted toilets and recirculating toilets. The standards for these devices must not be less than those established by the American National Standards Institute, Inc. (ANSI) Z4.3-1979 "Minimum Requirements for Non-Water Carriage Disposal Systems" or its subsequent revisions.

7-9. Community Wastewater Treatment Systems

1. Primary treatment

a. *General.* Primary treatment is designed to remove the suspended solids from raw wastewater (Figure 7-4). This is accomplished by mechanical means such as screening and sedimentation; however, additional treatment is required before the wastewater will meet EPA and state effluent standards.

b. *Screening.* Various forms of screens are used to remove large solid materials from influent wastewaters that could clog or damage pumps or otherwise hinder the flow of sewage through the plant. The screening devices take various forms depending on the existing conditions at each locality and the plant design. They include racks and bar screens which intercept large debris; perforated plates and fine screens to remove smaller objects; and comminutors and cutting screens which reduce the size of the solids.

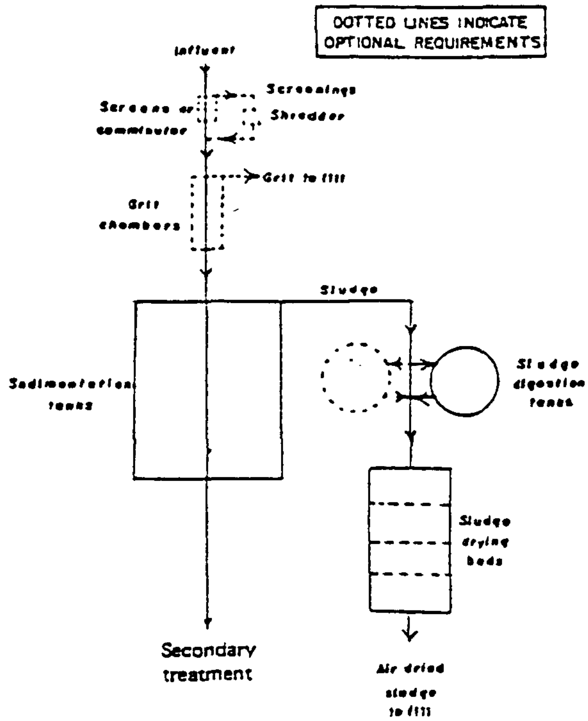


Figure 7-4. Schematic diagram of primary sewage treatment

c. *Wet Wells.* Flow through the treatment system is often regulated by a wet well which collects the fluctuating flow of influent wastewater and feeds it through the system at a relatively even rate.

d. *Grit Chambers*

(1) Grit chambers are designed to remove sand and other gritty material that may damage pumps and valves, accumulate in sedimentation tanks or clog sludge drains. They are particularly important in plants that receive wastewater from combined storm and sanitary sewers since the influent from the sewers is high in gritty material.

(2) The grit is removed when the velocity of the wastewater is decreased sufficiently to cause the heavy inorganic materials to settle while the organic solids remain sus-

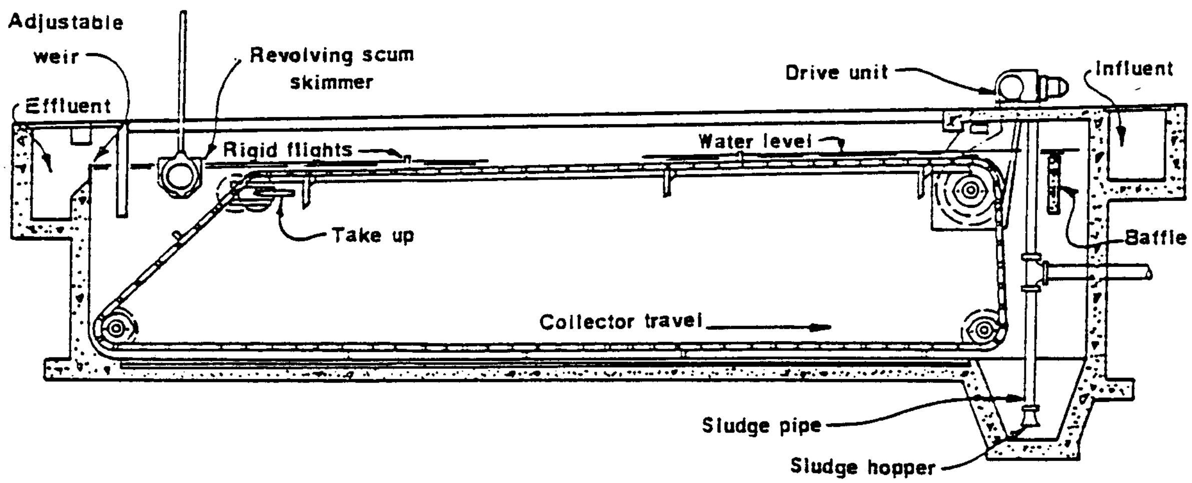


Figure 7-5. Rectangular sedimentation tank, chain sludge collector

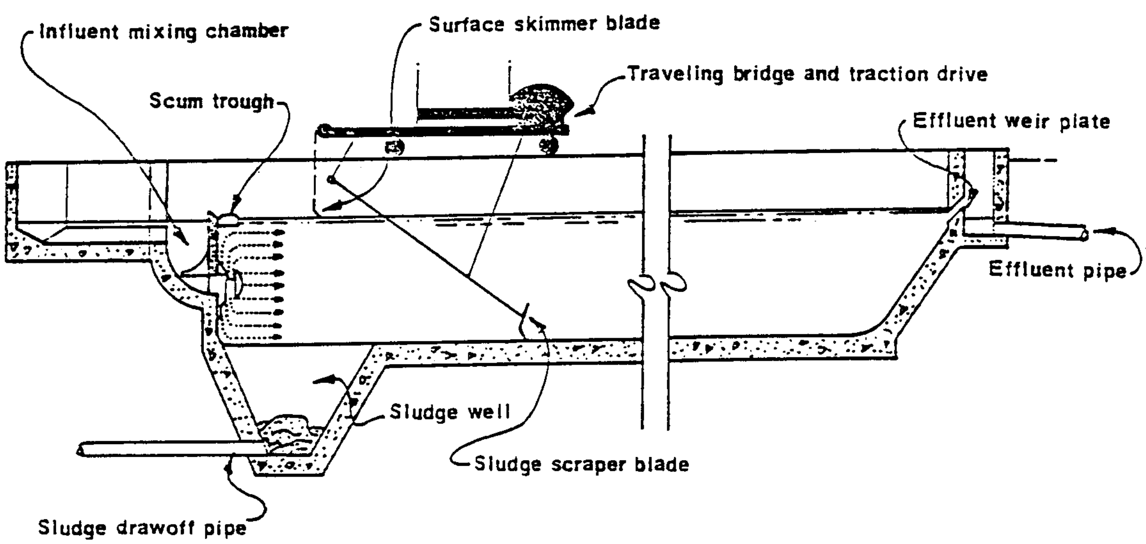


Figure 7-6. Rectangular sedimentation tank, traveling bridge collector

pended. There are usually two grit chambers arranged in parallel so that one remains in operation while the other is cleaned.

(3) The accumulated grit is removed from the chamber either manually or mechanically. The washed grit is relatively inoffensive and can be used in landfills.

e. *Sedimentation Tanks.*

(1) Sedimentation involves removal of a large part of the suspended solids from raw wastewater. Sedimentation is used in both primary and secondary treatment processes and, when employed in a primary treatment process, is designated as "primary sedimentation ."

(2) Plain sedimentation and chemical precipitation are two types of sedimentation used in wastewater treatment operations.

(a) Plain sedimentation with separate sludge removal is a common practice. The influent enters either a circular or rectangular sedimentation tank (Figures 7-5 and 7-6) where the flow rate is slowed and distributed evenly across the tank by a system of baffles, weirs, and multiple inlets. The slow even flow allows solids to settle to the bottom of the tank as sludge. The sludge is removed from the bottom of the sedimentation tank to a digester through pipes under hydrostatic pressure or suction. The sludge must be routinely removed in order to prevent its decomposition in the sedimentation tank resulting in the release of gases to the surface which would hinder effective settling and produce malodors.

(b) Chemical precipitation of wastewater is sometimes used to enhance the settling process. In this method chemicals such as lime, alum, ferrous sulfate, and/or ferric chloride are added to the wastewater before it enters the sedimentation tank. As the chemicals mix with the wastewater they form an insoluble gelatinous floe which settles rapidly, carrying with it most of the suspended solids in the wastewater. This method is most often used when industrial wastewaters are being treated.

(3) Mechanical skimming devices are installed on most sedimentation tanks to remove scum and oil products which float on the surface of the wastewater.

(4) The outlet weir of the sedimentation tank extends across the full width of rectangular sedimentation tanks and around the periphery of circular ones to ensure a smooth even flow. The effluent continues on to secondary treatment or to final disposition.

f. *Efficiency.* Primary treatment removes only a portion of those substances which are in the suspended state, leaving the colloidal and dissolved substances in the liquid effluent. Between 40 to 75 percent of the suspended matter is removed depending on the concentration, the retention time in the sedimentation tank, and the evenness of distribution and flow in the tank. The BOD is reduced 30-40 percent.

2. Secondary Treatment

a. *General.* Secondary treatment involves removal of most of the colloidal and dissolved organic materials in the wastewater. This is usually accomplished under aerobic conditions by biological oxidative decomposition and production of biological growths that are removed in secondary sludge. Activated sludge, trickling filters, and stabilization ponds are most often used to maintain aerobic conditions and the intimate contact between the wastewaters and organisms necessary for the removal of the pollutants.

b. *Activated sludge*

(1) In the activated sludge process of wastewater treatment (Figures 7-7 and 7-8), effluent from the primary sedimentation tank flows into an aeration chamber where it is mixed with sludge that has been aerated and thereby "activated" with aerobic bacteria to form a mixed liquor. The mixed liquor is thoroughly agitated by compressed air which is applied through diffusers or jets at the bottom of the aeration tank or by a stirring device which agitates the mixed liquor so air can be absorbed from the atmosphere. Wastewater is continually fed into the aeration chamber where microorganisms within the activated sludge act upon the organic wastes.

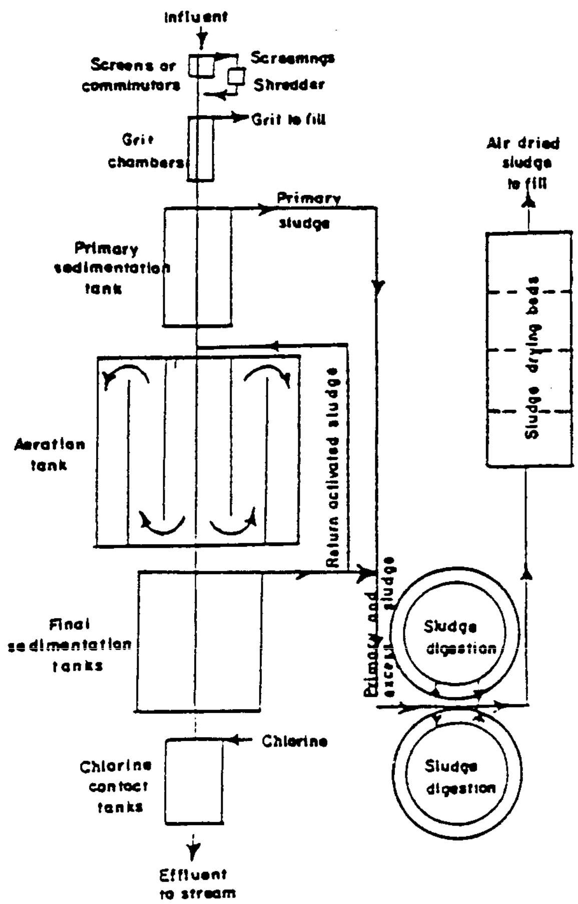


Figure 7-7. Schematic flow diagram of secondary treatment using activated sludge

(2) The primary agents in the activated sludge process are aerobic bacteria. Also playing an essential role are secondary feeders called holozoic protozoa. Primary bacteria in activated sludge are maintained in the endogenous or declining growth phase., This system allows the primary bacteria to die and lyse, releasing their cell contents to the solution. In doing this, organic matter is continually synthesized by various groups of bacteria. The holozoic protozoa live in a prey-predator relationship, assisting in the continued removal of the bacteria which stimulates further bacterial growth resulting in accelerated extraction of organic matter from solution. In addition, the flocculation (clumping) characteristics of activated sludge are improved by reducing the number of free-floating bacteria in the solution. The better the flocculation characteristics of the sludge, the better the overall rate of sludge settling.

(3) A portion of the sludge volume is continually recirculated from the secondary sedimentation tank or clarifier to the aeration chamber to ensure that adequate levels of biological activity are maintained within the tank. In addition, this recirculation process allows for the additional breakdown of organic materials within the sludge.

(4) The activated sludge process, under proper conditions, is very efficient, removing 85 to 95 percent of the solids and reducing the BOD the same amount. The efficiency of activated sludge systems is dependent on many factors including climate and characteristics of the wastewater. Toxic

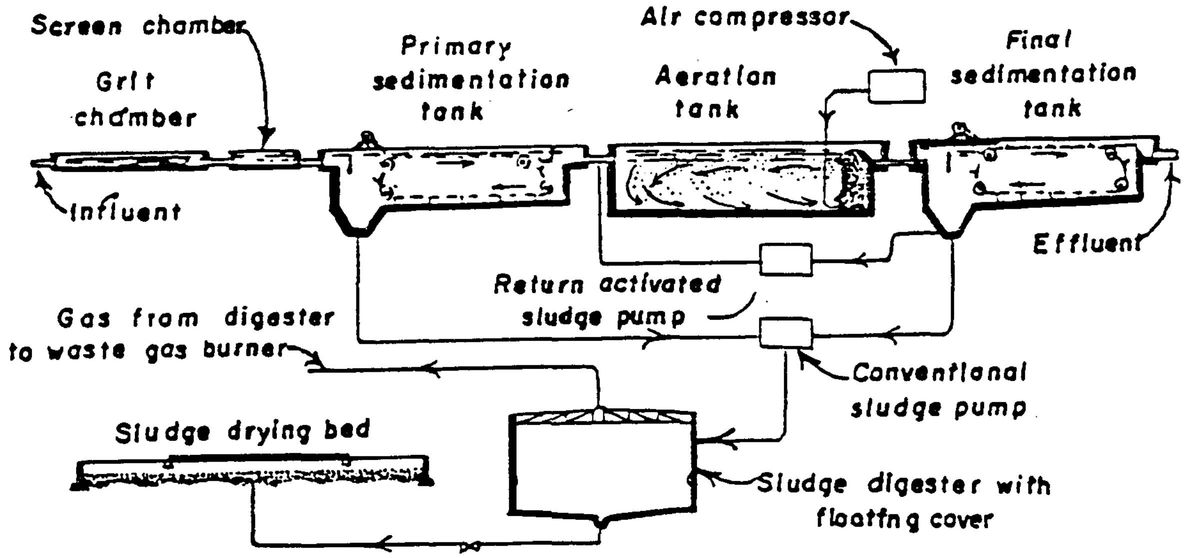


Figure 7-8. Cross section of a secondary treatment plant using activated sludge treatment

industrial wastes can disrupt the biological activity of these systems and wastes heavy in soaps or detergents can cause excessive frothing and thereby create esthetic or nuisance problems. In areas where industrial and sanitary wastes are combined, industrial wastewater must often be pretreated to remove the toxic industrial chemical components before being subjected to activated sludge treatment.

c. *Trickling Filters*

(1) The trickling filter (Figure 7-9) is a system designed to achieve BOD reduction through biological action on dissolved organic and finely divided solids. The filter bed (Figure 7-10) is usually of circular construction. Liquid sewage is evenly distributed over the upper surface of the bed by means of rotating arms. The influent is sprayed over the filter bed from a height of about 12 inches to ensure equal distribution over the entire filter bed surface.

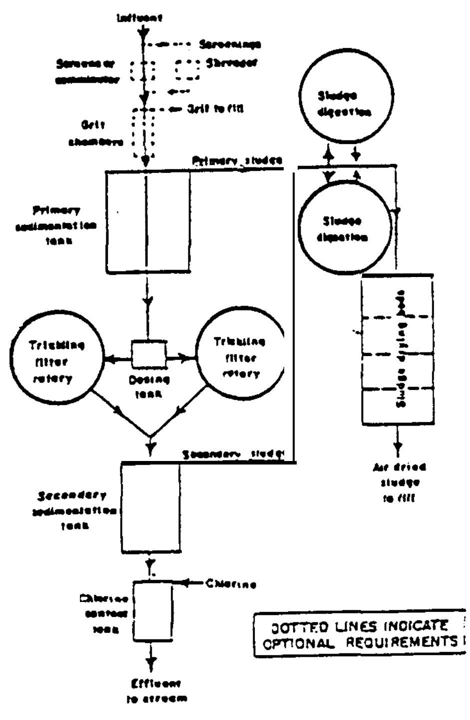


Figure 7-9. Schematic flow diagram of secondary treatment with trickling filter

(2) Filter packing is typically composed of rocks that are 2-1/2 to 4 inches in diameter placed within circular tanks with a depth of 3 to 8 feet. More recent constructions use a plastic packing material and have depths up to 40 feet. The filter bed is constructed with an underdrain system that not only removes the effluent to the secondary sedimentation basins but allows for free circulation of air throughout the bed to support the growth of aerobic bacteria and other organisms upon which the process depends.

(3) The active portion of the trickling filter system is the biological slime that forms upon the rocks. This film of biological growth is referred to as the zooglea. It consists of layers of bacteria, protozoa, and fungi.. In addition, the surface of the bed may support algae growth when temperatures and sunlight are optimal. The lower portion of a deep filter frequently supports the growth of nitrifyng bacteria. As the sewage flows down through the filter bed, the suspended and colloidal organic solids remaining after primary treatment are either digested or oxidized as they come into contact with the jelly-like layer of living organisms. As the layer of zooglea builds up, air is not able to penetrate its thickness. Anaerobic bacteria develop between the film and the stone, creating gas which loosens the zooglea which falls free and flows onto the secondary sedimentation basis where it settles and contributes to the formation of sludge. Aerobic bacteria then develop again on the stone surface and the process begins once again. The self-cleaning process makes the trickling filter a very economical and efficient form of treatment. However, this type of system is not readily adaptable where climate conditions include severe winter conditions.

(4) Two types of trickling filters currently in use are the standard and high rate. The standard rate trickling filter is dosed intermittently as the raw wastewater enters the plant, while the high rate filter is dosed continuously. High rate filtration is accomplished by recirculating a portion of the liquid from the filter. This process increases the efficiency of the process by preventing the beds from drying out and maintaining the optimum amount of zooglea. Continuous dosing also reduces problems such as fly breeding, freezing, and odors.

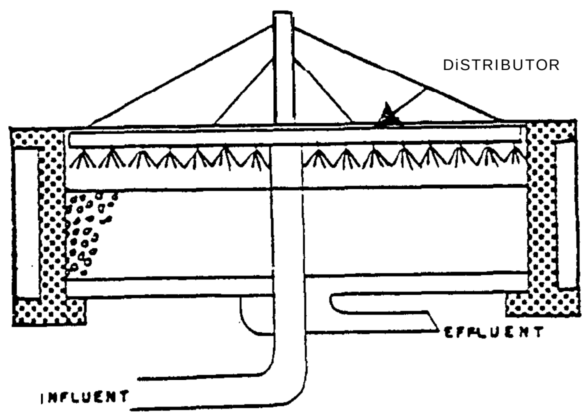


Figure 7-10. Cross section of Trickling filter

(5) As noted in Figure 7-9, wastewater flows from the trickling filter tank into the secondary sedimentation tank, where large volumes of sludge are settled from the wastewater. The effluent is then sent to a chlorine contact tank for disinfection and discharged to a receiving body of water. Sludge is continually removed from both primary

and secondary settling basins and processed for disposal.

(6) Filter flies (Psychoda) often become a nuisance but can be controlled by closing the effluent drain and flooding the filter to a depth of 4 inches above the rock surface for 24 hours at weekly or biweekly intervals. To be continually effective, the filter must be flooded at intervals frequent enough to prevent the flies from completing their life cycle between flooding.

d. *Stabilization Ponds*

(1) Stabilization ponds, also referred to as oxidation ponds or lagoons, are shallow basins used for aerobic and anaerobic degradation of wastewater. They maybe employed as the sole treatment process or in combination with other processes such as primary treatment. They are also used for waste storage, equalization of flow and quality, and sedimentation.

(2) Stabilization ponds are constructed as shallow flat bottom ponds enclosed by embankments of earth. Ponds must be lined with compacted clay or other impermeable material to prevent leaching. They can be round, square, or rectangular but should not have a length greater than three times their width. The liquid depth is maintained between 2 and 5 feet with approximately 3 feet of embankment freeboard. The minimum depth of two feet is required to prevent the growth of root aquatic plants. Depths of over five feet may lead to an odor problem. The size of a stabilization pond is determined by the size of the population it serves and the anticipated BOD load. A rough approximation of anticipated need is 1 acre for every 2,500 persons served by the pond. When a pond size is over 6 acres, it should be divided in segments or cells.

(3) Algal photosynthesis is the key element in the ecology of an aerobic stabilization pond. Aerobic populations of bacteria supply carbon dioxide for algal growth, which is turn supply oxygen to the wastewater which helps to maintain the aerobic balance. Waste organics in the water are metabolized by bacteria. In addition, the pond may contain secondary feeders including protozoa, rotifers, and crustaceans.

(4) If accumulating sludge deposits become too thick, the pond can turn anaerobic and organic constituents would then be digested in the same way as they would in an anaerobic digester. Because of this tendency to become anaerobic, most ponds occasionally emit odors. For this reason, ponds should be located as far as possible from existing or planned development areas. Thought must also be given to the direction of the prevailing winds. In some areas, ponds are mechanically aerated to ensure that aerobic conditions are maintained.

(5) Stabilization ponds are best located in warm, dry climates where large land areas are available. Depending on climate conditions, BOD reduction in a stabilization pond can range from 50 to 90 percent.

7-10. Disinfection

1. *Chlorination*

a. Chlorine is normally applied to sewage for two reasons: prechlorination for the control of the hydrogen sulfide in sewage; and final chlorination for disinfecting purposes, i.e., to destroy pathogenic bacteria and other undesirable biological life in the effluent.

b. The use of chlorine prior to actual treatment of the wastewater serves two purposes. Since chlorine is an active oxidizing agent, it is able to breakdown the hydrogen sulfide in the wastewater. This helps to prevent corrosion by reducing the potential of the hydrogen sulfide to mix with water and form sulfuric acid. In addition odors are eliminated by the removal of hydrogen sulfide. When prechlorination is employed, it is important that an excessive amount of chlorine is not used since the bactericidal action of free residual chlorine may interfere with the biological processes of the secondary treatment system.

c. The bactericidal action of chlorine results from its strong oxidizing power on the bacterial cell's chemical structure, destroying the enzymatic processes required for life. Disinfection of wastewater is defined as the addition of sufficient chlorine so that a free chlorine residual of between 0.5 ppm and 0.7 ppm exists after a 30 minute contact time. The amount of chlorine required to maintain the residual varies greatly depending upon the composition, temperature, and flow rate of the wastewater. Frequent monitoring and adjustment of chlorine flow is needed to maintain uniform results.

2. Other chemicals are occasionally used as disinfecting agents in wastewater treatment processes. These include bromine, iodine, and ozone. However, these chemicals are more often used in swimming pools, spas and/or for drinking water treatment. Chlorine is still the most effective way of disinfecting domestic wastewater.

7-11. Advanced Wastewater Treatment

1. *General*

a. Advanced wastewater treatment (AWT) refers to processes and methods that are designed to remove more contaminants from wastewater than are usually removed by conventional treatment operations. The term tertiary treatment is often used when discussing AWT, but the two are not precisely the same in meaning. Tertiary suggests a single additional step in wastewater treatment beyond secondary treatment. Advanced treatment means any process or system not now in common use or a system that may modify or replace one or more steps of conventional treatment. An example of this would be the addition of chemicals in a conventional activated sludge process to precipitate phosphorus.

b. As stricter water quality requirements are placed on wastewater treatment facilities, advanced processes for wastewater treatment are becoming more common. AWT systems are used to remove additional BOD, suspended solids, nitrogen, phosphorus, and pathogenic bacteria. In addition, many facilities that have industrial operations must treat their wastes to remove heavy metals, dissolved solids, color or specific inorganic substances. The technology for performing advanced wastewater treatment is changing rapidly. The basis systems presented here are used with a wide variety of modification and under an equal variety of conditions for advanced wastewater treatment.

2. *Chemical Coagulation*

a. Chemical coagulation is the process in which a chemical agent is introduced into the wastewater to help remove both organic and inorganic colloidal suspensions in the waste. The colloids found in wastewater consist of discrete particles held in suspension. Their extremely small size prohibits them from precipitating out of solution under normal circumstances. These particles may range in size from 1 to 200 nanometers.

b. There are two types of colloidal suspensions: hydrophilic and hydrophobic. Hydrophilic colloids readily disperse in water. Their lack of tendency to agglomerate depends upon a marked affinity for water. Hydrophilic colloids include soaps, soluble starch, and synthetic detergents. Hydrophobic colloids possess no affinity for water and get stability from their inherent electrical charges. This charge causes repulsion beween particles and is referred to as the zeta potential. Metal oxide colloids are examples of hydrophobic solutions.

c. For coagulation to occur, destabilization of the colloidal particles is necessary. Destabilization employs two mechanisms. The addition of electrolytes in solution reduces the net electrical repulsive force at the particle surfaces. Flocculation facilitates bridging between particles.

d. There are two operations involved in the coagulation process. *Mixing* is the process wherein a dissolved coagulant material is rapidly dispersed with violent agitation throughout the water being treated. *Flocculation* involves the continuous agitation of wastewater at much slower velocities to allow for the agglomeration of very small particles into well defined floes that settle readily.

e. The most widely used coagulant for wastewater treatment are aluminum and iron salts. Waters high in organic matter are best treated with aluminum sulfate. Ferric compounds are useful in removing odor problems. Aluminum sulfate and ferric chloride are the coagulant of choice for the chemical coagulation of phosphorus from wastewater.

f. In many cases, coagulant aids are also added to the mixing tanks to adjust the pH of the solution to optimize coagulation. Coagulant aids include activated silica, polyelectrolyte compounds, and clay.

g. Coagulation processes are most often carried out in the secondary sedimentation chamber.

3. *Biological Vitrification and Denitrification*

a. Biological vitrification is the process by which ammonia nitrogen (NH_3) is converted to nitrate (NO_3). Vitrification does not remove the nitrogen but only changes its form. Removal of the ammonia eliminates the demand for oxygen and the resulting problem of ammonia toxicity. This oxygen requirement is often referred to as the nitrogenous oxygen demand (NOD).

b. Two groups of bacteria are responsible for carrying out the vitrification process. They are *Nitrosomonas* and *Nitrobacter,* both of which grow aerobically by obtaining carbon from inorganic sources such as carbon dioxide (CO_2). These nitrirying bacteria are present to some extent in all types of aerobic waste treatment procedures. Their growth rate, however, is very slow when compared to bacteria which are BOD removers. In order “to foster the vitrification process, long detention times are needed (24 hours), the mixed liquor suspended solids concentration must be high, the sludge must be well aged, and wastewater temperature has to be maintained above 12°C.

c. Vitrification can be accomplished in one or two stage systems. In a single stage system, BOD reduction and vitrification occur simultaneously during an extended aeration activated sludge process. Two-stage vitrification requires separate aeration chambers for BOD removal and vitrification. This system is most successful for treatment of waste with high ammonia concentrations.

d. In some areas, nitrate can be safely discharged in the effluent. However, if this is not allowable, the denitrification process must be undertaken. Denitrification refers to the biological process of reducing nitrate (NO_3) to nitrite (NO_2) and then to nitrogen gas. This is accomplished under anaerobic conditions by facultative bacteria in the presence of biodegradable organic matter. The nitrate ion serves as an oxidizing agent and is reduced to nitrogen gas in the process.

e. To achieve a satisfactory rate of denitrification, the nitrogen must be in the nitrate (NO_3) or nitrite (NO^2) form; there should be no dissolved oxygen present; and there must be some BOD present to drive the process. Temperature control is essential since the rate of reaction falls off proportionally to a decrease in temperature.

f. Three systems are presently used for the denitrification process. They include anaerobic ponds, anaerobic sludge and anaerobic filters.

4. *Ammonia Stripping*

a. Water soluble ammonium ions exist in wastewater solutions in equilibrium with ammonia gas. If the pH of a wastewater solution is raised to a value of 10.5, the equilibrium is shifted in favor of ammonia gas causing it to be formed. In order to accomplish this shift, lime is usually added to wastewater streams to adjust the pH. Ammonia gas may then be removed from the wastewater by stripping with air, as the waste is passed through a slot filled cooling tower equipped with an air blower. The wastewater is allowed to enter the top of the cooling tower at a rate of 1 to 4 gallons per minute per square foot of tower. As the water flows through the packing, air is injected into the system countercurrent to the water. The ammonia gas is subsequently striped from wastewater.

b. When proper balance between pH, air flow rate, tower depth, temperature, and hydraulic loading is maintained, 90 percent of the ammonia can be removed. After stripping is completed, the pH of the effluent is readjusted in order to conform to local effluent standards.

5. *Filtration and Microscreening*

a. Filtration is used for removal of finely divided suspended material after an effluent has been subjected to secondary clarification or chemical precipitation units. In removing the suspended matter, filtration helps to significantly reduce phosphates, COD, and BOD.

b. Filtration can be accomplished by using filter beds made of diatomaceous earth, sand or mixed media. Wastewater flows through the filter bed where suspended solids are entrapped. After a period of operation, flow through the filter is obstructed by the entrapped material. When this occurs, the filter must be taken off line and backwashes before filtration can continue. If this cleaning is not completed, short-circuiting within the filter bed may occur, resulting in poor effluent quality. Filtration can achieve suspended solid values of 1 to 20 milligrams per liter depending on the efficiency of biological processes that preceded it.

c. A microstrainer can also be used to provide the same results achieved by a filter bed. A microstrainer is a screen in the form of a partially submerged rotating drum. Influent wastewater enters the inside of the drum from one end and flows out through the filtering screen depositing solids on the inner surface of the screen. The screen is continually washed and the solids are collected and returned to the beginning of the treatment system. Pore size in a microstrainer is between 50 and 60 micrometers. The flow rate is maintained between 5 and 10 gallons per minute per, square foot of submerged screen. One major disadvantage of the microstraining technique is the occasional buildup of grease and biological growth (slime). Extensive and frequent cleaning of mircostraining equipment is required to control these problems.

6. *Ion Exchange.*

Ion exchange is the exchange of one type of electrically charged particle for a different type. A solid material containing exchangeable ions is placed in a bed or column and the wastewater to be treated is then passed through it. Ion exchange systems are used to soften water, selectively remove specific impurities, and recover valuable chemicals lost in industrial waste discharges. Specific applications include the recovery of calcium and magnesium ions from solutions by exchanging them with sodium ions in beds of sodium zeolite, and the removal of ammonia by the use of a natural occurring zeolite material called clinoptilolite. Synthetic organic cation (positively charged ions) exchanges are available for capturing sodium, potassium, calcium, and magnesium ions. Ion exchange beds have a limited capacity. When the number of ions available for exchange are used up, the system or bed must be regenerated; that is, treated to restore the ion exchange capacity.

7. *Activated Carbon*

a. Activated carbon treatment is used to remove refractory soluble organics not removed by coagulation. These substances include nonbiodegradable organics, color, COD, and odor producing compounds and other organics. Adsorption by means of activated carbon can be accomplished in two ways. Powered carbon can be added to a sedimentation basin where it is mixed, flocculated, and settled from the waste. More frequently, activated carbon columns or counter flow beds are used. Removal of the organics occurs by adsorption of the less polar molecules, filtration of large particles, and deposition of colloidal material. The degree of waste removal is controlled by the length of contact time between the carbon and the water.

b. Carbon used in the activated carbon system is generated by high temperature activation of coal. Activation results in the formation of a network of micropores throughout the carbon which gives it adsorptive characteristics. As the carbon loses its adsorptive and filtering capacity, an increase in the COD of the wastewater is noted. The spent carbon is then regenerated.

c. Carbon removed from a column or bed for regeneration is first dewatered and then placed in a multiple-hearth furnace. The activated carbon is thermally regenerated by heating to a temperature of 1500 to 1700” F where adsorbed impurities are volatilized and released in a gaseous form. Approximately 10 percent of the carbon is lost per regeneration cycle.

8. *Land Application*

a. In some remote areas, wastewaters are disposed of by means of land application. In these projects, wastewaters are run onto grasslands and plowed fields or channeled by means of irrigation systems. These areas are often referred to as sewage farms. The use of wastewater for these purposes provides benefit from the water and the fertilizing components of the waste. When using primary effluent, attempts must be made to limit direct contact with crops. Sewage farms are a rarity in the U.S.

b. In some instances, secondary effluent of high quality can be used for irrigation and spray purposes. The use of water for these purposes is controlled by the effluent standards and disposal criteria established by the state government. Any projects involving land application or reuse of wastewater effluent must be coordinated through NAVFACENGCOM Engineering Field Divisions and BUMED.

7-12. Sludge Digestion and Disposal

1. General. Primary treatment of domestic wastewater creates a sludge which contains approximately 65 percent organic material. The bulk of this sludge is composed of the solids settled from the wastewater. Secondary treatment sludge contains about ,90 percent organic material. Advanced wastewater treatment methods create a sludge composed of either a chemical or biological waste, depending upon the composition of the wastewater and the treatment procedure used. Before ultimate disposal of sludge can occur, it must be rendered innocuous. Therefore, most sludges are subjected to digestion processes prior to terminal disposal. The intention of sludge digestion is to convert the bulky odorous and putrescible waste into a well digested sludge which can be easily dewatered and is relatively odor free.

2. *Anaerobic Digestion*

a. In an anaerobic digestion process, the organic matter in the waste sludge is decomposed in the absence of molecular oxygen. The end products of anaerobic decomposition are methane gas (CH4), carbon dioxide (C02), unused intermediate organics, and a small amount of cellular protoplasm.

b. There are two main groups of microorganisms responsible for anaerobic digestion. These are bacteria from the acid-forming group and the methane-forming group. The acid-formers convert the complex organic matter to low-molecular weight fatty acids such as acetic, propionic, and butyric acids, also known as volatile acids. The methane forming bacteria convert the volatile acids to methane and carbon dioxide. This is a simultaneous process dependent upon a carefully controlled environment within the digester. Any shift in the delicate balance will result in a decrease of the efficiency of the system. Anaerobic digester failure can result from a sudden increase in organic loading, a sharp decrease in digestive sludge volume, an increase or decrease in the temperature or the presence of an inhibitory substance.

c. Anaerobic digesters are large cylindrical tanks with bottoms sloping toward the center so that the sand, grit, and heavy sludge can be removed. In early construction, digesters were not covered; however, today most digesters have either a floating top (Figure 7-11) or a fixed cover (Figure 7-12). Most digesters are equipped with heaters to help maintain adequate sludge temperatures within the tank.

d. It is most important that air not be allowed into the digester. In a fixed cover system, new sludge must be added to the system every time the finished sludge is drawn off. The floating lid digester moves up and down with the tank level and the gas pressure.

e. The gasification process produces about one cubic foot of the per capita per day. The gas contains approximately 2/3 methane and 1/3 carbon dioxide. In many areas the methane produced by anaerobic digestion is used as fuel for the treatment plant. It can be used to heat the digester, or used in the overall plant heating system. Some plants use the methane as incinerator fuel or in internal combustion engines to run pumps and compressors.

f. There are two principle classifications of digesters; conventional (standard rate)

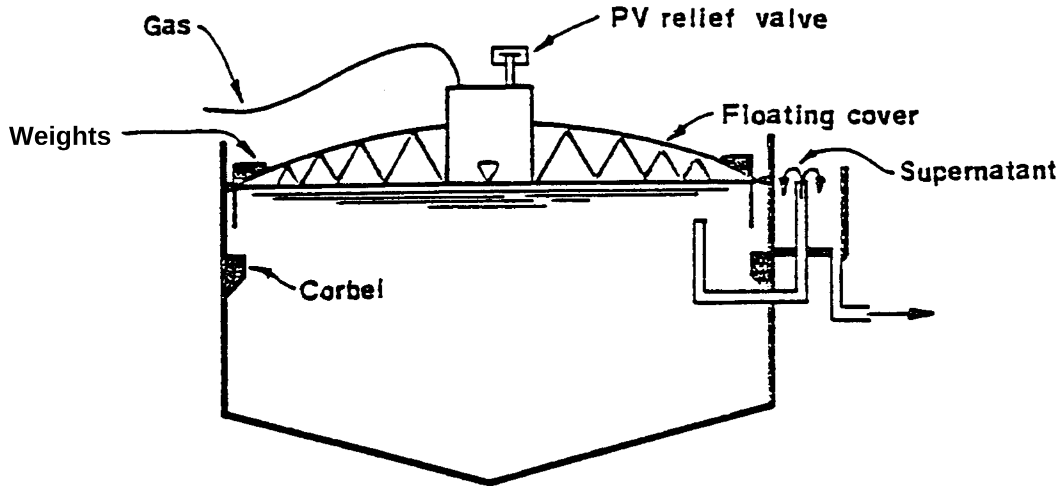


Figure 7-11. Floating Cover Digester

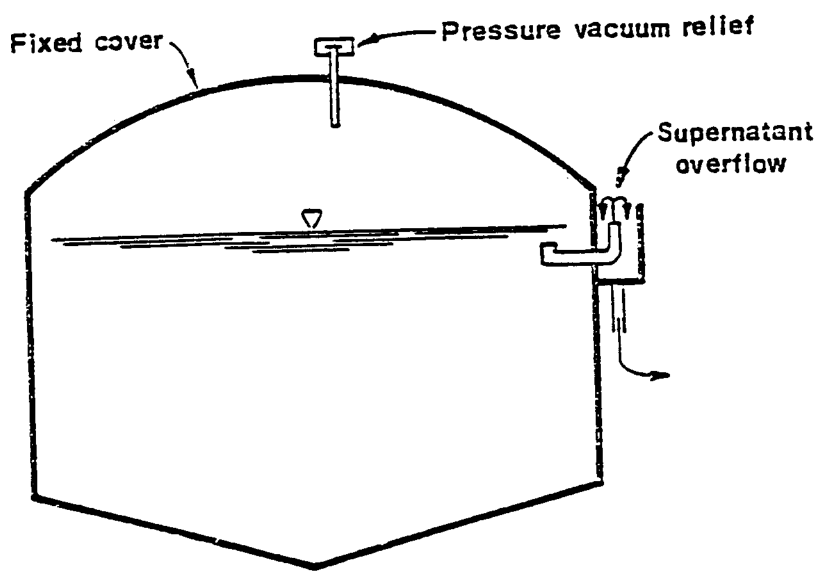


Figure 7-12. Fixed Cover Digester

and high rate digesters. The primary difference between the two systems is that the high-rate or two-stage system has a mixing tank or cycle which allows for higher loading rates and continuous feeding and withdrawal of sludge. Detention time in the conventional digester is 30 to 90 days, while the high-rate unit has a detention period of 10 to 20 days.

g. A liquid layer is formed during the digestive process. This layer is referred to as the supernatant. It contains a high concentration of organics and is rich in nitrogen and phosphorus. It must be returned to the wastewater treatment cycle at a point where it will have the least effect.

3. *Aerobic Digestion*

a. Aerobic digestion is another biological process for treating organic waste sludges prior to terminal disposal. In this system, waste sludge is subjected to extended aeration for a period of 12 to 25 days. During this time, the microorganisms in the sludge break down the organic material. As the supply of nutrients in the sludge decreases, the organisms consume their own cell material and reduce the organic content even further.

b. Aerobic digestion is accomplished in one or more tanks mixed by diffused aeration. Multi-stage systems use the first tanks to accomplish most of the digestion. The last stage is used for solids concentration. A supernatant is produced during this step and must be recycled.

c. The major advantages to aerobic sludge digestion include the production of a more stable sludge, fewer odor problems, and no safety problems related to the production of methane and carbon dioxide. However, aerobic digestion produces a sludge which is difficult to thicken, resulting in disposal problems.

4. *Sludge Conditioning, Dewatering, and Final Disposition*

a. Sludge handling and disposal is a major part of the wastewater cycle. Even after digestion, sludge handling and disposal is difficult because of the water which is still a major part of the overall sludge volume.

b. Sludges are often conditioned for subsequent dewatenng or disposal. Thickening, elutriation, and chemical coagulation are conditioning steps used prior to dewatering.

(1) In the thickening process, the sludge is placed in specifically designed tanks. The sludge is continuously stirred for periods of 6 to 24 hours, during which time the supernatant water is continually drawn off. The continual stirring dislodges gas bubbles, prevents bridging of sludge solids, and keeps the sludge moving toward the center well of the tank. The thickening process usually doubles the sludge concentration.

(2) Elutriation is the process by which a digested sludge is washed prior to further conditioning. The process involves the extraction of alkaline carbonate, phosphates, and fine sludge particles from the sludge. The alkalinity is removed to reduce the amount of coagulant necessary for mechanical dewatering. Elutriation is carried out in tanks similar to sedimentation tanks. Rapid mixing of sludge and washwater is carried out just prior to entering the sedimentation tanks.

(3) Sludge is often chemically treated prior to undergoing the dewatering process. The addition of certain chemicals helps to bring about coagulation of the solids and also produces a more rapid release of the water from the sludge. Chemicals used in this process include lime, ferric chloride, ferric sulfate, alum, and organic polymers.

c. Dewatering reduces the moisture content of the sludge so that it can be handled and disposed of in a solid form rather than as a liquid. The three principal methods of dewatering sludge are drying beds, vacuum filtration, and centrifugation.

(1) Sludge drying beds are used where the sewage plant flow is limited and land is available. The beds are composed of a gravel bed covered with a layer of sand between 6 and 12 inches in depth. A tile underdrain system is often placed under the gravel bed to improve water removal. The bed area is divided into cells of approximately 20 by 50 feet. The sludge is drawn off from the digester and poured into the bed. Sludge is poured to a depth of 8 to 10 inches. The dewatering of sludge is due to drainage and evaporation. The major portion of sludge drying is accomplished in the first 3 to 5 days. Drying times depend on the initial water content and weather conditions, and may range from one to three weeks. Using sludge beds, it is possible to obtain a sludge water content of approximately 25%.

(2) Vacuum filters are used for sludge dewatering at medium to large size treatment plants where large land areas are not available for sludge drying beds. Vacuum filters can also be used to handle raw sludge that has not been digested. The vacuum filter consists of a large drum on which a filter media has been placed. This media can be made of cloth, synthetic fiber, stainless steel mesh or coil springs. The drum rotates so that approximately 1/4 of it is submerged in the sludge. Vacuum pressure applied to the drum causes sludge to cake on the drum surface. As the drum rotates, the water is drawn from the sludge by the vacuum. The dewatered sludge is then scraped off the filter and collected in a hopper. Moisture content of the dewatered sludge is approximately 60-75 percent.

(3) Treatment plants handling large volumes of waste material may use a centrifuge for dewatering sludge. Centrifuges separate solids from the liquid by sedimentation and centrifugal force. Sludge for centrifugation is usually chemically conditioned prior to being dewatered. The sludge produced in the use of the centrifuge has a water content of between 65 and 75 percent.

d. After the solids produced in wastewater treatment operations are stabilized and reduce in volume, the problem of terminal disposal still remains. The only acceptable disposal alternative is disposal on land.

e. Sludge lagoons are a long-term method of storing sludge and are used where there is a large land area available. Lagoons are natural or artificial basins with an average depth of 4 to 10 feet that are lined with clay or other impermeable material. Digested sludge, when placed in a lagoon, will continue to dewater by means of evaporation. Liquid that settles to the bottom of the beds must be collected by a leachate control system and transported off site for further treatment or disposal. After lagoons have filled up and the sludge has completely dried, the lagoon can be dug out and the sludge residue used for fill. Sludge which has been poorly digested may create an odor problem.

f. Sludge that has been dried on beds can be successfully disposed of on land. In some areas, liquid sludge that has not been digested is poured directly onto the ground from tank trucks. This can be very beneficial to the soil, however, one must be made aware of the possible health hazards. Raw sludge must be carefully monitored since this sludge may contain considerable quantities of disease producing organisms. It should not be used as a general soil conditioner or fertilizer if people are to be in contact with it. The area that has raw sludge disposed on it should not be used for root crops or low growing vegetables that may be eaten raw. Particular attention should also be given to ground water and surface water runoff. Special care and attention should be given to sludges containing high concentrations of heavy metals. These types of sludge wastes must not be disposed of in an agriculture setting.

g. Disposal of dewatered sludge in a properly run sanitary landfill is one of the best disposal methods available. Since the sludge is buried and covered with a layer of soil, nuisance conditions are kept to a minimum.

7-13. Industrial Wastewater Treatment and Disposal

1. The character of industrial wastewater varies as widely as industrial processes. Industrial wastes include organic chemicals, such as phenols and chlorinated hydrocarbons; corrosive wastes, including acids and alkalies; toxic chemicals, such as cyanide and heavy metals; greases and oils; radioactive wastes, thermal pollution, and many others. Many of these industrial wastes can be very disruptive to domestic wastewater treatment systems by inhibiting or otherwise interfering with the treatment processes and causing major sludge handling and disposal problems. In addition, these wastewaters can adversely affect the quality of the receiving waters into which they are discharged.

2. Problems concerning the treatment and disposal of industrial wastewaters at Navy and Marine Corps facilities must be brought to the attention of the public works officer or the responsible NAVFACENGCOM Engineering Field Division.

7-14. Health Precautions for Wastewater Treatment System Personnel

1. This section provides information regarding health precautions and other preventive measures recommended for personnel who work with wastewater treatment systems.

2. Those personnel who are in contact with wastewater, or who work in or inspect wastewater treatment plants, must keep their basic immunizations current. Immunizations required include polio, tetanus, and diphtheria.

3. Wastewater treatment plant personnel must not eat, drink, or smoke when performing maintenance on or inspecting equipment which may be a direct source of contamination.

4. In the event of a significant wastewater spill, those cleaning the area must wear coveralls, rubber boots, rubber gloves, hair coverings, and face shields. Upon completion of spill clean-up, contaminated clothing must be removed and placed in a plastic bag for laundering. Clean-up personnel must take a hot shower, using plenty of soap and water, promptly after spill clean-up is completed. Caution must be exercised when cleaning sewage spills in confined spaces. The gases given off by sewage can be explosive, toxic and/or displace the oxygen in the space.

5. Clean-up of wastewater spills may be accomplished using detergent and water, followed by thorough rinsing. Disinfection of the spill area is required in food service, berthing, and medical spaces. Disinfection may also be helpful in preventing odors in other areas. Recommended disinfectants are listed in Article 7-20.

6. In the event of a major leak or spill, the cognizant medical department must be notified.

7-15. Medical Department Responsibilities

1. Cognizant medical department representatives must periodically inspect wastewater treatment facilities in order to detect potential

health hazards to operators and the surrounding community.

2. Medical department representatives must be alert to any increase in disease incidence among treatment plant operators or members of the surrounding community which may be attributed to exposure to human wastes.

health hazards to operators and the surrounding community.

2. Medical department representatives must be alert to any increase in disease incidence among treatment plant operators or members of the surrounding community which may be attributed to exposure to human wastes.

Section III. WASTEWATER TREATMENT AND DISPOSAL AFLOAT

7-16. Introduction

1. The overboard discharge of untreated sewage within the navigable waters of the U.S. and territorial seas (within 3 nautical miles of shore) is prohibited. Navy vessels are equipped with marine sanitation devices (MSDs) which either treat sewage before discharge, or 'collect and hold it until it can be properly disposed of through dockside sewer connections or pumped overboard in unrestricted waters.

2. MSDs on Navy ships increase the potential for contamination of berthing and working spaces with raw sewage. Therefore, the medical department representative (MDR) must be familiar with the sewage disposal system and the procedures necessary to ensure the health and safety of the ship's crew.

3. There are three different types of marine sanitation devices including zero discharge systems with full volume flush (FVF), zero discharge systems with controlled volume flush (CVF) and flow through treatment systems.

a. The zero discharge system with FVF is a system which uses a standard 3-5 gallon flush and is able to store sewage in holding tanks until it can be properly discharged. The Collection Holding and Transfer (CHT) System is a zero discharge, FVF system.

b. Zero discharge systems with CVF collect, treat, and/or store sewage from toilets and urinals until it can be properly discharged over the side or otherwise disposed of through dockside facilities. They differ from the FVF system in that they minimize the volume of wastewater. This is accomplished in various ways including reduction of the flushing medium followed by evaporation of the excess water, using a controlled volume vacuum flush system and incinerating the wastes, or recirculating the flushing medium. Examples of this type system include the GATX Evaporative Toilet System, the JERED VACU-BURN System and the KOELHER-DAYTON Recirculating Flush System. Some newer ship classes (e.g., DDG 51) use a vacuum collection CVF system without incineration.

c. The flow through treatment system treats wastewater to acceptable limits and discharges the effluent into receiving waters. The Pall-Trinity Biological Treatment System is the only example of this type currently authorized.

7-17. Marine Sanitation Device Systems Descriptions

1. *Collection Holding and Transfer System*

a. CHT systems have been installed on the majority of Navy ships. The systems are designed to operate in three modes; in restricted waters, sewage is collected and stored in holding tanks while gray water is discharged overboard via diverter valves; at sea, all sewage and gray water, including any stored in the holding tanks, is diverted or discharged overboard; and in port, sewage and gray water are collected in holding tanks and discharged into a sanitary sewer or ship waste off-load barge (SWOB).

b. The CHT system is composed of three fictional elements:

(1) The collection element consisting of soil drains (from toilets and urinals), gray waters drains (from showers, laundries, and galleys) and diverter valves which direct the wastewater over the side or to the holding tanks.

(2) The holding element, consisting of tanks, retains sewage during transit of restricted waters for eventual disposal. These tanks are normally sized for a 12-hour holding period depending on individual ship constraints. Holding tanks of 2,000 gallon (Figure 7-13) capacity and over are designed with comminutors to macerate solids passing into the tanks and an aeration system to prevent sludge from settling and becoming anaerobic. Smaller tanks, on the other hand, (Figure 7-14) incorporate strainers which prevent solids from entering tanks.

(3) The transfer element includes sewage pumps, overboard and deck connection discharge piping and associated diverter valves and check valves. Each tank is equipped with two sewage pumps which are connected in parallel to discharge sewage and gray water to a receiving facility, SWOB, or directly overboard.

c. The CHT system can be operated in a manual mode in which the pumps are actuated independent of the level of wastewater in the holding tanks or in a fully automatic mode. When operating in a manual mode, an option is available which will deactivate the pumps automatically when the low liquid level of the tanks reaches approximately 10% of the tank volume in order to maintain pump suction. In the fully automatic mode, the following functions are accomplished:

(1) Duty pump alternation.

(2) The low liquid level stops the pump when the level reaches approximately 10% of its capacity in order to keep the pumps primed.

(3) At 30% liquid level, a sensor signals the duty pump to activate.

(4) At 60% liquid level, a sensor signals the standby pump to activate.

(5) At 80% liquid level, a visual and audible high level alarm is activated.

2. *GATX Evaporative Toilet System*

a. This system is a modular system suitable for small vessels. It is designed to operate in two modes. In restricted waters, the volume of wastewater generated is minimized by a reduction in flushing medium using CVF water closets and urinals. In restricted waters, the liquid portion of the wastewater is vaporized leaving a concentrated sludge residue which can be stored for approximately two weeks, if required. In unrestricted waters, wastewater can be diverted overboard, and pier side it may be discharged directly into a shore receiving facility.

b. The GATX System (Figures 7-15 and 7-16) is comprised of CVF urinals and water closets, macerator/transfer (M/T) pumps, a stream jacketed evaporator with electrical heaters, an odor treatment system, sludge pump, system controls, and associated plumbing.

c. Bodily wastes enter the system through the CFV urinals and water closets and are fed directly to the M/T pump where they are reduced to a slurry. The slurry is either pumped directly overboard or to the evaporator tank. The evaporator tank is team heated to 2300 F causing the liquid portion of the wastewater to vaporize. The remaining sludge accumulates at the bottom of the tank until it can be discharged into a port receiving facility or into unrestricted waters. The evaporator tank is designed to accommodate approximately two weeks' accumulation of sludge.

d. The vapor treatment system eliminates the malodors caused by the vaporization of wastewater. This is accomplished when the vapors are heated to 500° F and passed through a catalyst where the malodorous components of the vapor are oxidized and thus destroyed.

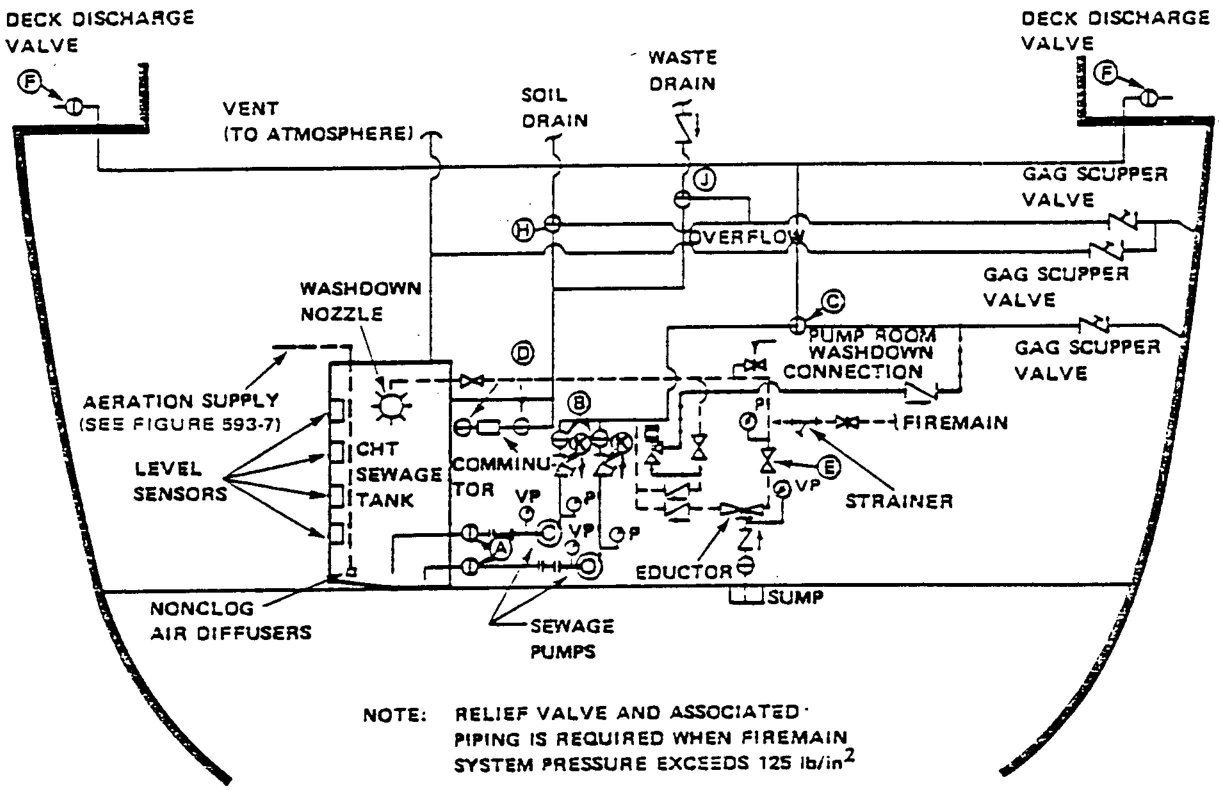
3. *JERED Vacu-Burn Treatment System*

a. The JERED Vacu-Burn System (Figure 7-17) is installed aboard ships of the DD 963 and DDG 993 class. The system employs CVF water closets and urinals, a vacuum collection tank (VCT), grinder pump, overboard discharge pump, incinerator feed pump, two vacuum pumps (or a fire main powered eductor for vacuum generation), a vortex incinerator and associated plumbing and controls.

b. Soil waters are introduced into the system via CVF water closets and urinals. The wastes are transported to the 240-gallon vacuum collection tanks under negative pressure of 14 to 20 inches of mercury. The negative pressure is maintained by two vacuum pumps or a fire main powered eductor. Upon reaching the VCT, the wastes are passed through a grinder pump which macerates the waste to 1/4 inch or less size particles.

c. There are four level sensors in the vacuum collection tank. The low level sensor deactivates the overboard incinerator and grinder pumps when the wastewater level drops below the 40-gallon level. The grinder pump will activate above this level. A sensor located at the 100-gallon level activates the incinerator feed pump, or the overboard discharge pump, whichever mode is selected. A high level alarm is positioned at the 175-gallon level which activates an alarm at the control panel. The warning signal indicates that there may be a casualty malfunction. A very high level alarm is located at the 200-gallon level. In addition to sending alarm signals, this sensor deactivates the wastewater collection system by deenergizing the vacuum pumps or fire main eductor. The system cannot be reactivated until the malfunction has been corrected and the wastewater level drops below the 200 gallon level.

d. During operation in restricted waters, the wastewater is incinerated at approximately 2,0000 F in a vortex incinerator. The resulting sterile ash is removed when the incinerator cools down and is disposed of as solid waste. Each incinerator is capable of treating 4,000 pounds of sewage per day.



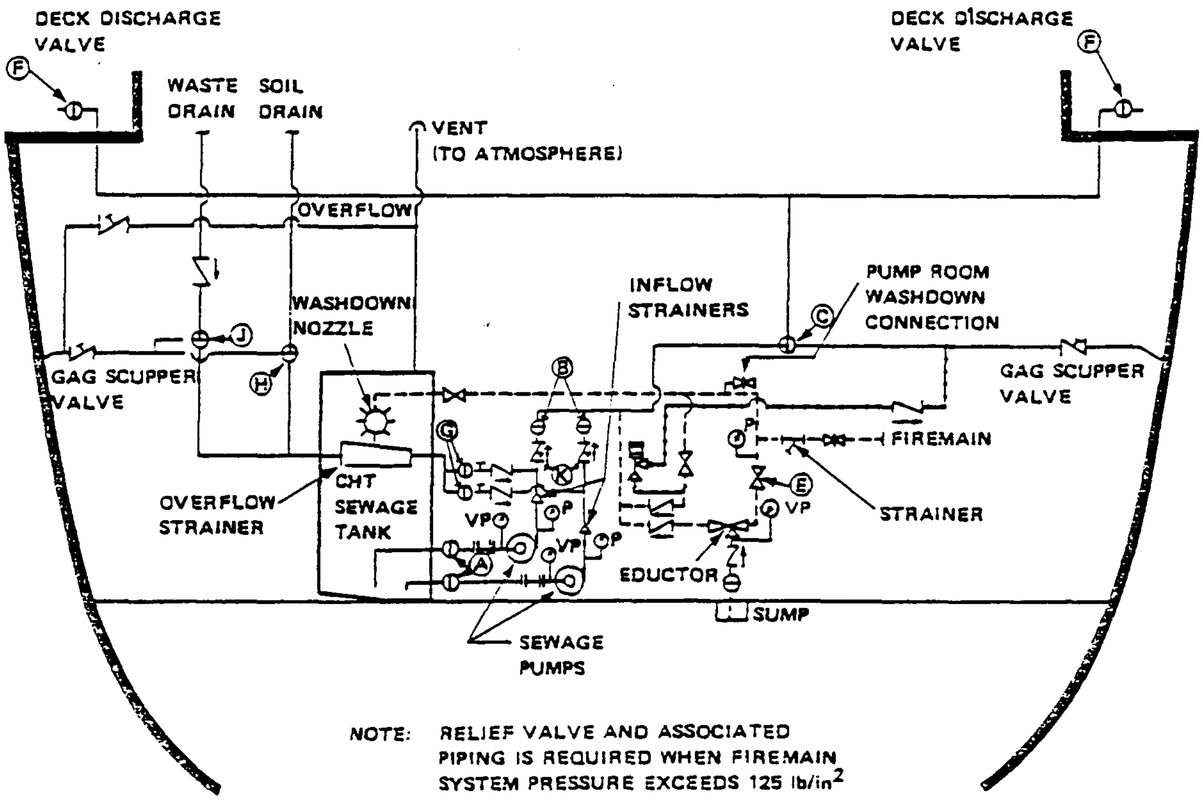
LEGEND:

- Ⓐ PUMP SUCTION VALVE
- Ⓑ PUMP DISCHARGE VALVE
- Ⓒ PUMP DISCHARGE DIVERTER VALVE
- Ⓓ COMMINUTOR ISOLATION VALVE
- Ⓔ EDUCTOR SUPPLY VALVE
- Ⓕ DECK DISCHARGE VALVE
- Ⓗ SOIL DRAIN DIVERTER VALVE
- Ⓙ WASTE DRAIN DIVERTER VALVE
- Ⓚ PUMP DISCHARGE CHECK VALVE

SYMBOLS KEY:

- SWING CHECK VALVE
- SWING CHECK VALVE (WITH HOLD-OPEN DEVICE)
- GATE VALVE
- P PRESSURE GAUGE
- VP VACUUM PRESSURE GAUGE
- SPOOL PIECE
- 3 WAY VALVE
- STRAINER
- GAG SCUPPER VALVE
- PLUG OR BALL VALVE
- GLOBE VALVE
- RELIEF VALVE

Figure 7-13. Comminutor type CHT System.



LEGEND

- (A) PUMP SUCTION VALVE
- (B) PUMP DISCHARGE VALVE
- (C) PUMP DISCHARGE DIVERTER VALVE
- (E) EDUCTOR SUPPLY VALVE
- (F) DECK DISCHARGE VALVE
- (G) INFLOW STOP VALVE
- (H) SOIL DRAIN DIVERTER VALVE
- (J) WASTE DRAIN DIVERTER VALVE
- (K) PUMP DISCHARGE CHECK VALVE

SYMBOLS KEY:

- SWING CHECK VALVE
- SWING CHECK VALVE (WITH HOLD-OPEN DEVICE)
- GATE VALVE
- P PRESSURE GAUGE
- VP VACUUM PRESSURE GAUGE
- SPOOL PIECE
- 3 WAY VALVE
- STRAINER
- GAG SCUPPER VALVE
- PLUG OR BALL VALVE
- STRAINER FLUSHING CONNECTION
- GLOBE VALVE
- INFLOW STRAINER
- RELIEF VALVE

Figure 7-14. Strainer Type CHT System

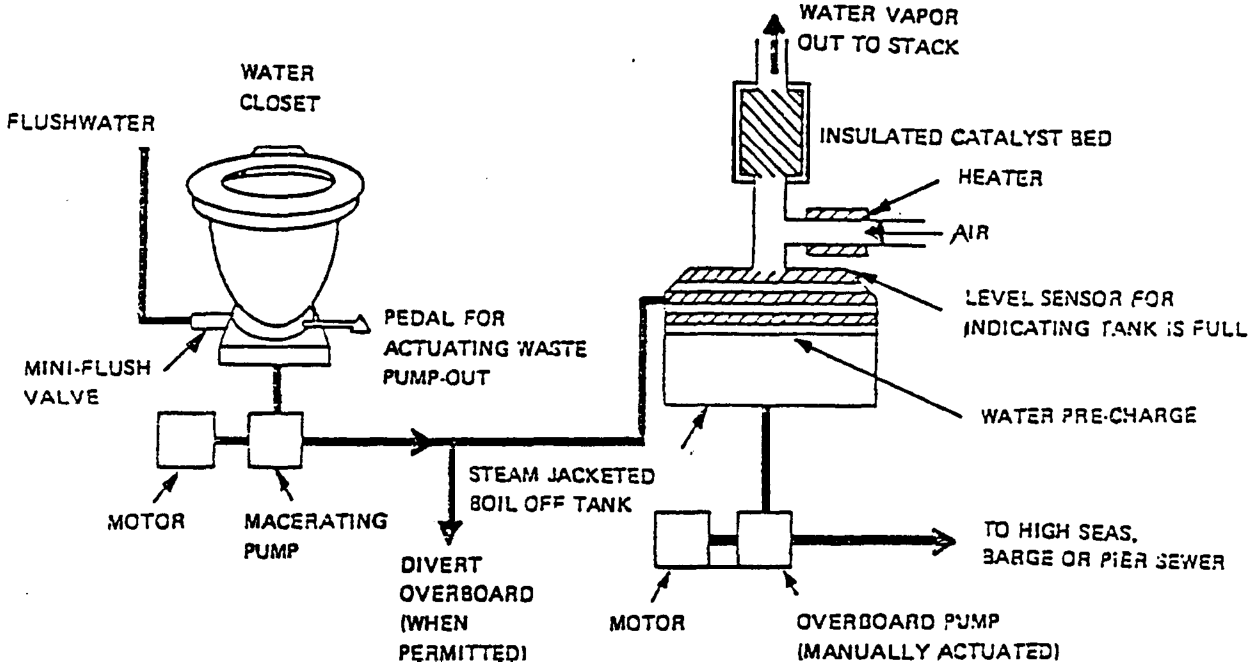


Figure 7-15. GATX Evaporative Toilet System

e. In unrestricted waters, wastewater is discharged directly overboard. In port, the wastes are incinerated or discharged directly into a shore collection facility or SWOB.

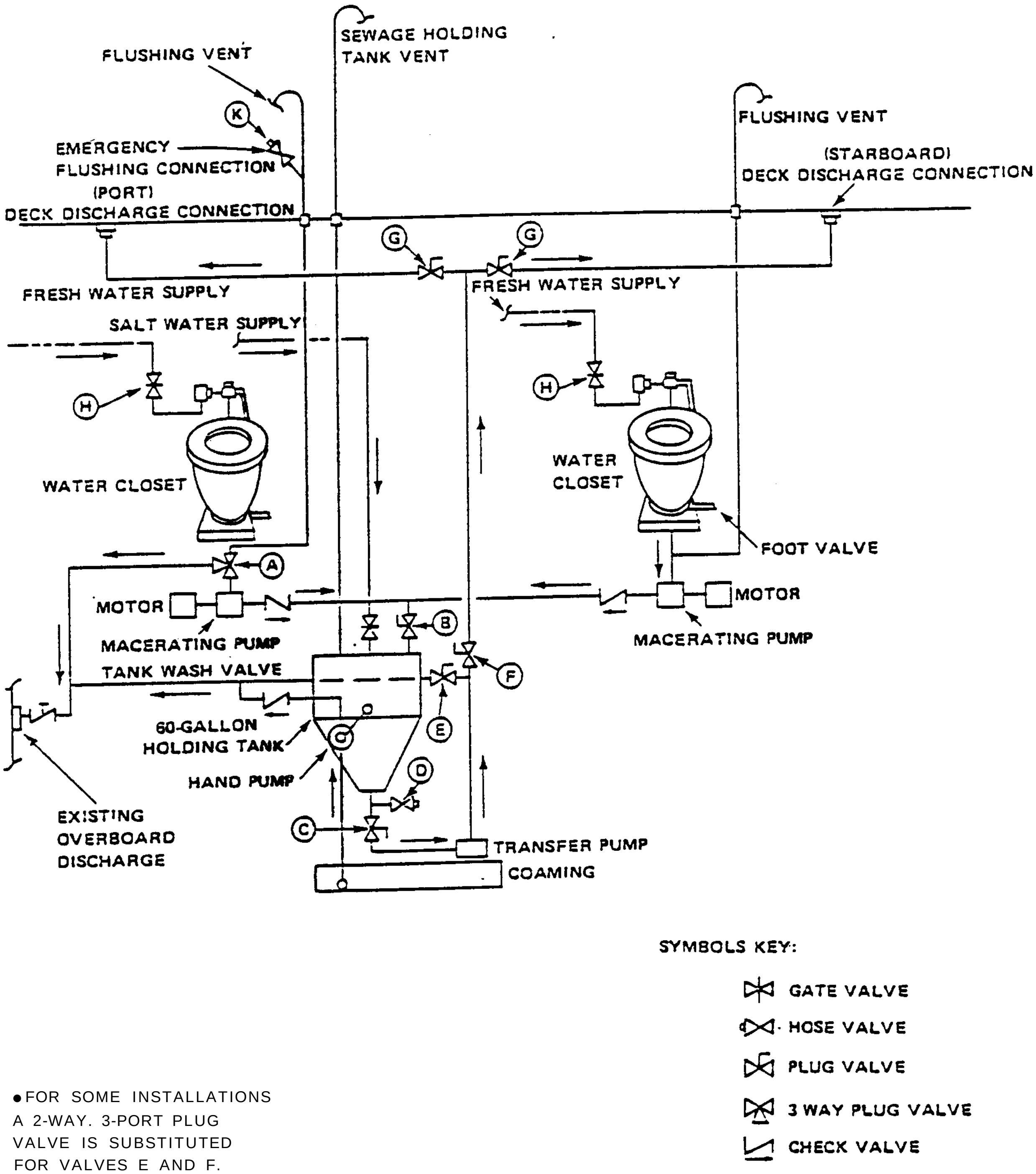
4. *KOEHLER-DAYTON (KD) Recirculating Flush System*

a. The Koehler-Dayton Recirculating Flush System is designed for small craft and ships whose mission requires extensive operations within the restricted zone.

b. This system consists of a recirculating flush toilet with a 20-gallon holding tank (KD unit), an electrical or manual recirculating pump, 30-gallon storage tank, and a macerator/transfer (M/T) pump for discharging both holding tanks, plus associated plumbing and controls.

c. The KD unit is initially charged with 4 gallons of fresh water to which is added 4 ounces of chemical-containing deodorizers, coloring and wetting agents, a biocide, and, in the event of freezing temperatures, antifreeze. Whenever the unit holding tank is drained into the 30-gallon storage tank or discharged overboard, the unit must be recharged with flushing medium.

d. Wastes are carried to the 20-gallon unit holding tank in the recirculating flush medium. The flushing medium is pumped from the unit holding tank through a filter or baffle device, where the solids are removed, and back to the toilet bowl for reuse. The 20-gallon unit holding tank is designed to accommodate approximately 160 uses before it must be emptied; however, the manufacturer recommends the unit be drained into



• FOR SOME INSTALLATIONS A 2-WAY. 3-PORT PLUG VALVE IS SUBSTITUTED FOR VALVES E AND F.

Figure 7-16. GATX MK2 System

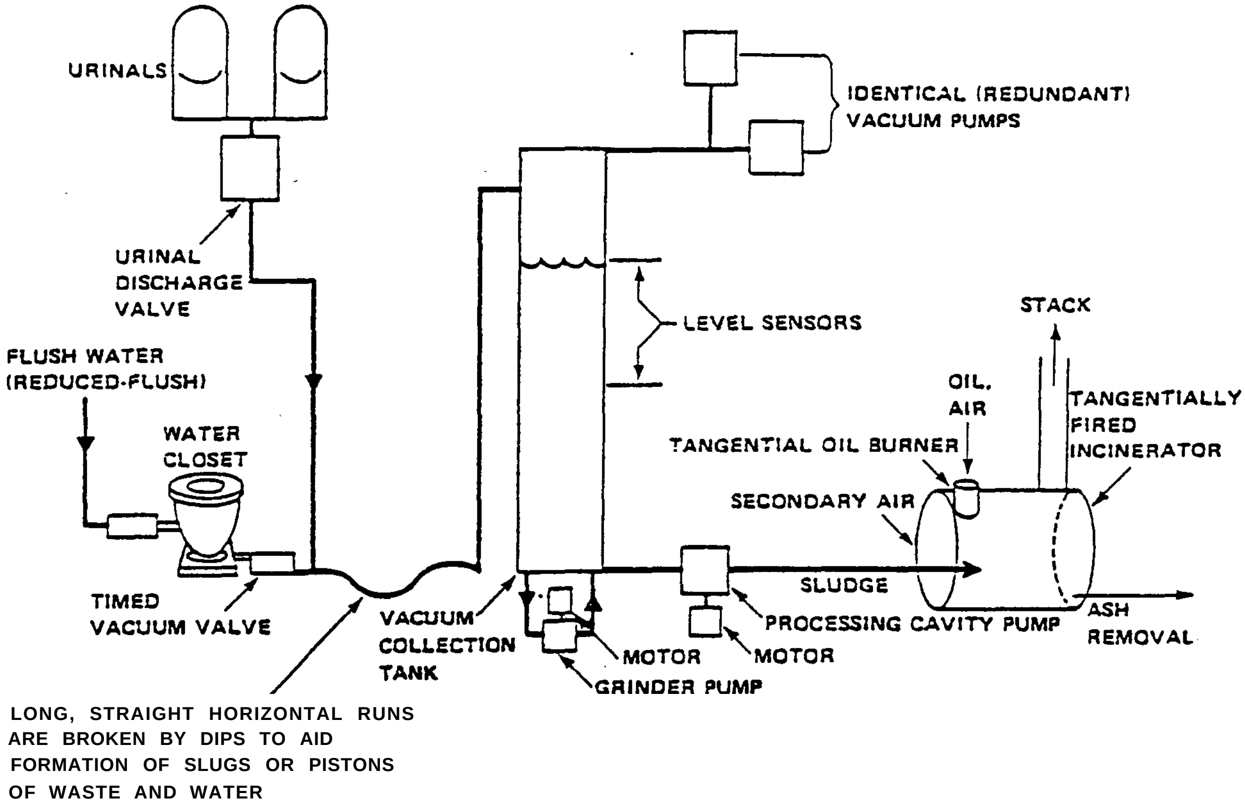


Figure 7-17. JERED Vacuum Collection and Incineration System

the storage tank or overboard as appropriate at two-day intervals, regardless of the number of usages, to assure odor-free operation.

e. The 30-gallon storage tank extends the amount of time the system can operate in restricted waters. When in port, the contents of the storage tank are discharged into the port receiving facility. In unrestricted waters the wastes are discharged directly overboard.

5. *Pall-Trinity Biological Treatment System*

a. The Pall-Trinity System (Figure 7-18) is a thermally accelerated, extended aeration activated sludge sewage treatment system on board LHA 1 class ships. It works on a principle similar to that described in Article 7-9.2b.

b. This system is comprised of FVF water closets and urinals, an influent box, bar screen, comminutor, aeration tank, aeration tank heater, air supply, sedimentation tank, sludge return lines, surface skimmer, effluent discharge pumps, chemical feed system, and associated plumbing and controls.

c. Sewage enters the treatment plant from FVF toilets and urinals through the influent box. From there, sewage passes through the comminutor into the aeration tank. In the event the comminutor becomes clogged, sewage enters the aeration tank through the bar screen. Sewage is decomposed in the aeration tank by aerobic bacteria in an environment rich in oxygen and maintained between 85°F and 105° F by the aeration tank heater. The effluent leaving the aeration tank enters the sedimentation tank where sludge settles to the bottom and is conveyed back to the aeration tank by the sludge return lines for further treatment. When the sludge accumulation in the sedimentation tank reaches 40% of the tank capacity, it is pumped out and discharged overboard in unrestricted waters or to a shore receiving facility. The scum, which forms at the top of the sedimentation tank, is removed by the surface skimmer and returned to the aeration tank. The clarified effluent from the sedimentation tank enters the effluent holding tank where chlorine is added to disinfect the treated wastewater before it is discharged overboard.

7-18. Inspection of Marine Sanitation Device:

1. *Labeling and Color Coding*

a. On the interior of the ship, MSD valve handles and operating levers (excluding handwheels of gauge valves located on gaugeboards) must be color coded gold (Paint Chip 17043). Exterior deck discharge stations must be painted the same color as the surrounding structure.

b. Deck discharge stations must be clearly labeled to include hose handling procedures and sanitary health precautions as described in GENSPECS 593.

2. MSD components must be regularly inspected for leaks by appropriate engineering personnel responsible for the compartment in which the MSD components are located. These inspections should include the following:

a. Soil and waste drains, discharge lines, flanges, joints, access plates, and clean out plugs.

b. Gate and ball valves

c. Plug valves

d. Comminutors and motors

e. Automatic pump starters

f. Sewage pumps, including housings and seals

g. Tank penetrations and manholes

h. Air compressors

i. Drip pans

j. When operating in "port" mode, include sewage transfer hoses and riser connections

3. The "paper towel" test can be used to pinpoint small leaks from pumps, comminutors and pressurized sections of the piping system. This test entails opening a paper towel and holding it suspended 2 to 3 inches from the units for several minutes while they are operating. The source of even the finest spray can be detected by the paper towel becoming spotted or wet.

4. The ventilation system installed in the MSD room must be inspected and the space sump (if present) must be checked for sewage accumulation.

5. All leaks, spills or other sources of contamination observed during these inspections or at any time must be promptly reported to the executive officer, engineering officer/ damage control officer, and the senior medical department representative. Appropriate action must be taken to arrest the leak and properly clean and, when appropriate, disinfect the contaminated area as described in Article 7-20.

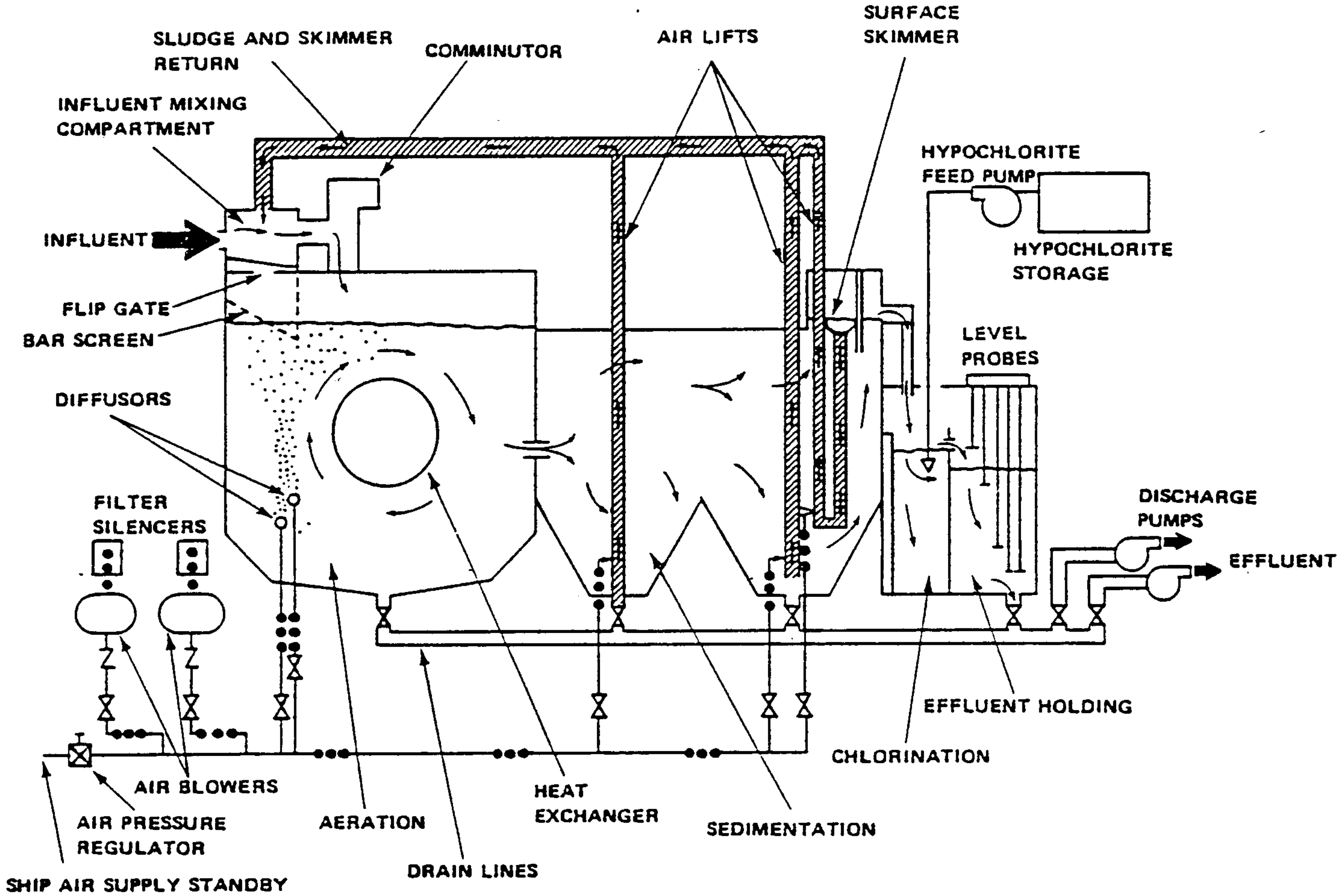


Figure 7-18. Pall Trinity Biological Treatment System

7-19. Ship to Shore Sewage Transfer

1. Sewage receiving facilities have been constructed at most shore activities with fleet support capability. These facilities include sewer risers located along all piers and quay walls for the transfer of sewage from the ship discharge risers to the shore sewer system. Also included are facilities to store, maintain and repair sewage transfer hoses. Specific information and guidelines concerning all aspects of ship to shore sewage transfer facilities and procedures are provided in NAVFAC Publication MO-340, *Ship-to-Shore Hose Handling Operations Manual.*

2. Navy MSDs are designed to discharge sewage to a shore receiving facility when in port. This may be accomplished directly by connecting the ship's sewage discharge risers to the pier sewer risers, or indirectly by connecting to a SWOB or another ship's system which in turn discharges the sewage into pier risers.

3. Ship-to-ship sewage connections (Figure 7-19) occur when several ships are nested at one pier, berth, or when a vessel is

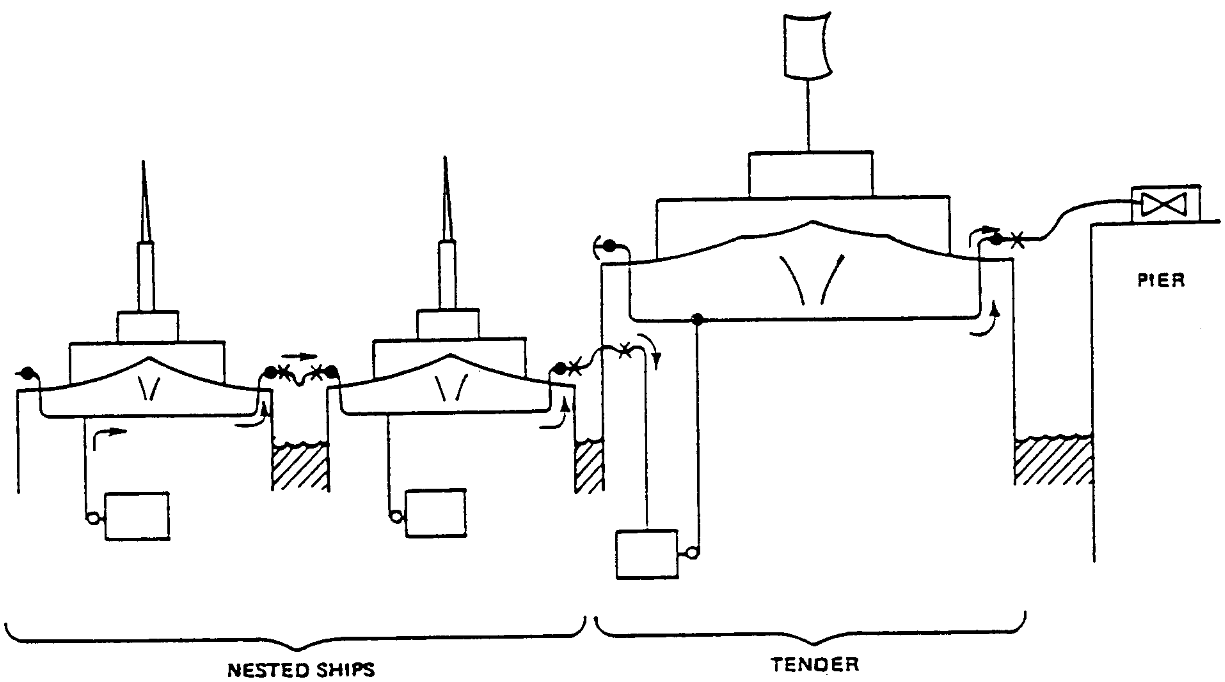


Figure 7-19. Nested Ship Sewage Transfer

nested to a tender. Ships with CHT systems have athwartship piping which allows them to receive sewage from an adjacent ship and transfer it to another ship with the same capability. Thus, several ships' CHT systems can be connected in series such that the sewage generated on these ships, is conveyed through the inboard ships' systems to the pier risers. Vessels with other than CHT systems do not have the pump-through capability and must be connected directly to a pier, SWOB, or a ship such as a tender which has pump-through capability.

4. Most sewage connections, including ship-to-shore and ship-to-ship, are made by means of 50-foot length, 4-inch flexible rubber or plastic sewage transfer hoses which are provided by the sewage receiving facility. The only exceptions are submarines which use a 50-foot length, 2-1/2 inch rubber hose. When a ship arrives for berthing, a shore based handling crew delivers the proper amount of clean sewage transfer hoses to the pier, and connects the hoses to the pier risers. The ship's crew is responsible for connecting transfer hoses to the ship's risers on ship-to-shore and ship-to-ship connections.

5. Sewage transfer hoses must be kept clean and in good repair to avoid unsanitary conditions. Prior to returning the hoses to storage after use, they must be cleaned of residual wastewater. This is usually accomplished by flushing the hoses for at least 10 minutes prior to disconnection with high pressure salt water which is admitted into the MSD discharge piping from the ship's fire fighting system. When a vessel does not have this capability, the shore crew must flush the hoses by connecting them to the nearest saltwater pier riser. In addition, hose couplings and exterior surfaces must be cleaned and the ends of the hoses capped prior to storage. Sewage transfer hoses must never be used for potable water connections.

6. In the event wastewater is spilled onto the -deck of the ship or onto the pier, the affected area must be thoroughly flushed into the harbor with high pressure salt or fresh water. An approved disinfectant such as NSN 6840-00-753-4797, disinfectant Germicidal Fungicidal concentrate (phenolic type) may be used to prevent or eliminate strong odors caused by the wastewater spill.

7. Sewage hose handling and storage facilities are designed to accommodate the repair, maintenance, and storage of sewage transfer hoses. Hose handling and storage facilities are required to incorporate the following design features to preclude conditions which could cause accidents or communicable diseases:

a. Racks and tables used for the handling and storage of sewage transfer hoses must be constructed of metal or other impervious material. Wooden racks and tables are prohibited.

b. All windows and doors which open to the outside must be adequately screened to prevent the entry of flying insects.

c. Back siphonage prevention devices must be installed on all potable water lines used for flushing and cleaning sewage transfer hoses.

d. Lavatories and showers with hot and cold running water, soap, and single use towels must be provided.

e. Sufficient ventilation must be provided in all indoor work spaces.

f. Incandescent and fluorescent lights must be protected from breakage, and nonslip surfaces must be installed on the deck in the hose washing areas.

g. Disinfection of sewage transfer hoses is not normally required; however, the hose handling facility should have this capability in the event the need arises.

h. The sewage hose handling and storage facility must be constructed, equipped and operated in conformance with appropriate health and safety requirements promulgated by the Occupational Safety and Health Administration (OSHA).

7-20. Personal Hygiene, Sanitation and Safety

1. Strict adherence to good personal hygiene and sanitary practices is essential to prevent the spread of fecal contamination and resulting potential for the occurrence of communicable diseases.

2. Personnel are required to wear protective clothing including coveralls, rubber boots, rubber gloves, face shields, hair covering and an oxygen breathing apparatus (OBA) as appropriate when contact with sewage is likely during maintenance, or spill clean-up operations.

3. Personnel who come in contact with sewage in the course of their duties, or as the result of a sewage spill or system backflow must adhere to the following requirements to minimize the spread of contamination to other areas of the ship.

a. Movement about the ship wearing contaminated clothing must be kept to an absolute minimum.

b. Contaminated clothing must be placed in a plastic bag at the conclusion of maintenance or spill clean-up operations for laundering in hot water and detergent. No special laundering procedures are required.

c. Rubber boots, gloves, OBA, and other similar items must be washed with hot soapy water, rinsed with hot clean water and treated with an approved disinfectant solution.

d. Personnel must thoroughly wash with soap and water before engaging in other activities. In the event of a sewage spill, all sanitary and safety requirements specified in Naval Ships Technical Manual (NSTM) 593 must be strictly followed.

4. Spaces which become contaminated with sewage as a result of leaks, spills, or sewage system backflow must be thoroughly washed down with water and a stock detergent. In addition, food service spaces,• berthing areas, and medical spaces must be treated with an approved disinfectant (EPA registered and labeled) such as NSN 6840-00-753-4797, Disinfectant, Germicidal Fungicidal Concentrate (Phenolic Type) or NSN 6840-00-526-1129, Disinfectant, Germicidal and Fungicidal Concentrate (Iodine Type). To be effective, these agents must be used in accordance with instructions printed on their respective labels.

5. Bilges contaminated with sewage wastes must be pumped out, washed down with a fire hose and pumped out again. If potable water tanks form the floor of the bilge, daily bacteriological monitoring of the water from those tanks must be promptly initiated and continued until it is assured that sewage contamination of the tanks has not occurred. Furthermore, if the potable water system is suspected of being contaminated, the appropriate tanks must be secured until the water is determined to be safe.

6. Signs must be posted in spaces containing MSD equipment warning maintenance personnel against consuming food and beverages or smoking in MSD spaces and directing them to thoroughly wash with soap and water prior to leaving the area.

7. Personnel who handle or connect sewage transfer hoses must not subsequently handle potable water hoses without first washing, and changing into clean clothing.

8. There must be no open flames, flashlights, or other electrical apparatus in or near open holding tanks or other voids until they have been certified safe by a gas-free engineer. When the tank is designated gas-free and safe, personnel may enter using an (OBA) or other approved respiratory protection device specified in NSTM Chapter 593. A safety harness and tending line must be used if only a single person enters the tank. If more than one person enters the tank, they must keep in constant sight of one another. Personnel must always be on hand outside the tank to watch those inside and the ready to lend assistance. See Article 7-22 and 7-23 for additional health and safety provisions.

7-21. Medical Department Responsibilities

1. The presence of marine sanitation devices and the associated equipment and facilities aboard ship increase the risk of exposure to untreated wastewater which in turn increases the potential for the occurrence of infectious diseases associated with human waste. Since preventive medicine is an integral part of the medical department responsibility aboard ship, it is incumbent upon the MDRs to become familiar with the MSD system aboard their ship; knowledgeable in the proper personal hygiene practices and decontamination procedures with regard to the operation and maintenance of MSD systems; and to take an active role to insure the systems are operated and maintained in a safe and sanitary manner.

2. The MDR's duties must include the following:

a. Conduct visual inspections of MSD components as described in Article 7-18 as part of the routine habitability and sanitation inspection program or on a more frequent basis as the situation dictates. Whenever practicable, inspections should be conducted in conjunction with engineering department personnel.

b. Indoctrinate personnel associated with the operation, maintenance, and repair of MSD systems concerning the potential health hazards associated with human wastes, proper personal hygiene necessary to reduce the risks associated with working with MSD systems, and the correct procedures for cleaning and disinfecting contaminated spaces. This training must be conducted on a periodic basis to ensure that the appropriate personnel are able to operate and repair the MSD system without endangering themselves or the ship's crew.

c. Provide on-site advice, when requested, in the correct procedures for personal protection and disinfection of spaces in the event of major sewage leaks or spills. The MDR must be present for clean-ups and disinfection of food services spaces, living areas, and medical spaces.

7-22. Safety and Health Hazards of CHT Systems

1. A serious potential hazard associated with CHT systems is that toxic or explosive gases could be released in confined spaces. Hydrogen sulfide has been identified as the most likely gas hazard associated with the decomposition of sewage in CHT tanks, however, other gases may include methane, ammonia, and carbon dioxide.

2. The following precautions will minimize the potential hazards resulting from the release of toxic gases.

a. Insure that the installed CHT tank aeration system is operated properly in tanks larger than 2,000 gallons. The aeration system must be operated while transiting the three-mile zone or while in port as sanitary wastes are being collected. Systems with tank capacities of less than 2,000 gallons do not have aeration systems; but because of the smaller tank capacity, the CHT discharge pumps will cycle more often while in port.

b. Always assume the CHT tank contains sewage and toxic gases. Any maintenance requiring the removal or disassembly of valves, pumps, flanges, etc. inside the CHT pump room or below the CHT overflow must be conducted in accordance with the Naval Ships' Technical Manual, NAVSEA S9086-T8-STM-010, Chapter 593, Paragraph 4.21.2.1 through 4.21.2.10.

c. Personnel working in the CHT pump room, comminutor space, or any space containing CHT piping, must evacuate the space immediately if hydrogen sulfide is detected by a "rotten egg" smell or by a portable personal hydrogen sulfide alarm. A space in which hydrogen sulfide has been detected may only be reentered by personnel wearing air line respirators with full face masks.

d. Corrective maintenance not requiring immediate attention should be deferred until the ship is port and industrial facilities are available. In a situation where holding wastes presents a health or safety hazard, the system should be secured and an engineering casualty report filed. If retention of waste interferes with operational effectiveness, it may be diverted over the side.

e. Smoking, eating, or drinking is never permitted inside CHT pump rooms, comminutor spaces or when working on any CHT component.

7-23. CHT Pump Room Safely

1. In most cases, CHT pumps are located in very small compartments on lower deck levels. This provides an excellent collection basin for heavier-than-air gases, such as hydrogen sulfide.

2. To eliminate hazardous gas exposures in CHT pump rooms, it is strongly recommended that:

a. Slightly negative pressure ventilation, to include powered air supply and exhaust ventilation be installed in CHT pump rooms in accordance with General Specifications for Ships of the United States Navy (GENSPECS), Section 512. The exhaust ventilation ducting should extend to within 9 inches of the deck.

b. An indicator light be installed outside the compartment to indicate the ventilation system is operating.

c. Two emergency escape breathing devices (EEBD) be placed in each CHT pump room.

d. A portable hydrogen sulfide detector be used during all CHT maintenance.

e. A placard be installed at access to the CHT pump room stating the following:

SEWAGE SPILLS PRODUCE HAZARDOUS GASES

1. *SEWAGE SPILLS CAN PRODUCE HAZARDOUS GASSES*

2. *USE EEBD MOUNTED IN PUMP ROOM FOR EMERGENCY ESCAPE IN EVENT OF SEWAGE SPILL*

3. *FOLLOW SAFETY PROCEDURES IN NAVSHIPS TECHNICAL MANUAL, "POLLUTION CONTROL," NAVSEA S9086-T8-STM-010/CH-593 DURING SYSTEM MAINTENANCE OR SPILL CLEAN UP*

4. *USE OBA ONLY FOR EMERGENCY RESCUE AND DAMAGE CONTROL (SECURING OF FLOODING)*

f. The following label plate be placed in the vicinity of each CHT holding tank access and sewage tank access:

WARNING

TOXIC OR EXPLOSIVE GASES MAY EXIST IN THE TANK. DO NOT OPEN UNLESS AT A SUITABLE INDUSTRIAL ACTIVITY AND TANK HAS BEEN CERTIFIED GAS FREE IN ACCORDANCE WITH THE REQUIREMENTS OF NAVAL SHIPS TECHNICAL MANUAL, ENTITLED "POLLUTION CONTROL," PUBLICATION NAVSEA S98086-T8-STM-010/CH-593.

g. A safety watch with a spare OBA must be posted at the compartment access any time maintenance is conducted which requires the system to be opened in the pump room, or in any space below the CHT tank overflow.

Bureau of
Medicine and Surgery
Washington, DC 20372-5300

NAVMED P-5010-8 (Rev. Nov 2004)
0510-LP-103-1874

Manual of Naval Preventive Medicine

Chapter 8

NAVY ENTOMOLOGY AND PEST CONTROL TECHNOLOGY

DISTRIBUTION STATEMENT "A"

This publication supersedes NAVMED P-5010-8 (Rev. 9-87) S/N 0510-LP-642-6366

NAVMED P-5010-8

Chapter 8
Manual of Naval Preventive
Navy Entomology and Pest Control Technology

9 Nov 2004

To: Holders of the Manual of the Medical Department

1. Purpose. This revision reflects the latest Navy entomology and pest control technology.

2. Action. Replace entire chapter 8 with this version.

K. L. Martin

K. L. MARTIN
Vice Chief

CHAPTER 8
MEDICAL ENTOMOLOGY AND PEST CONTROL TECHNOLOGY

CONTENTS

CHAPTER 8
MEDICAL ENTOMOLOGY AND PEST CONTROL TECHNOLOGY

CONTENTS

SECTION I. NAVY ORGANIZATION FOR MEDICAL ENTOMOLOGY PROGRAMS

8-1. Definition of Vector

a. The term vector refers to organisms, primarily arthropods and rodents, which play a significant role in the transmission of disease to man, act as intermediate hosts or reservoirs of disease, present problems of sanitary or hygienic significance, or otherwise affect the health and efficiency of personnel. Included are arthropods such as mosquitoes, biting flies, filth and flesh flies, lice, bed bugs, reduviid bugs, fleas, mites, ticks, and mammalian pests such as rodents and bats. Cockroaches, ants, wasps, spiders, scorpions, and food infesting insects are pestiferous arthropods not ordinarily associated with specific diseases.

b. In addition to the vector pests described above, the definition of pests in this Chapter also includes those that are objectionable because of their presence. Organisms destructive to structures, stored products, grounds, and other material properties are classified as "economic pests." For information on economic pests, as well as for additional vector species, refer to the Armed Forces Pest Management Board publications, "Military Pest Management Handbook," and "Technical Guide 24: Contingency Pest Management Pocket Guide."

8-2. Policies for Pest Control

a. Department of Defense (DOD) Directive 4150.7, Pest Management Program provides basic standards and policies governing the Navy's pest control programs. This directive establishes minimum levels of pest control for DOD installations and program policies for pest management implementation.

b. Office of the Chief of Naval Operations (OPNAV) Instructions 6250.4, Pest Management Programs and 5090.1, Environmental and Natural Resources Protection outline pest control responsibilities and functions of the offices and commands of the Department of the Navy and establish policies to provide maximum effectiveness, efficiency, and safety in pest control operations.

(1) **Shore Activities**. Commanders of all shore activities of the Department of the Navy bear the basic responsibility for the maintenance of an adequate vector and economic pest control program. This responsibility is normally delegated to the medical and public works departments. The public works department is required to conduct pest control operations as a scheduled part of performed services. The medical department is required to plan and recommend vector control

measures and determine that all activities are conducted safely. Joint planning of the activity's pest control program by the public works and medical departments is necessary to ensure maximum effectiveness, efficiency, and safety.

(2) **Commands Afloat.** Commanders afloat are assigned responsibility for maintaining effective and safe shipboard pest control programs. The medical department is responsible for the operation and supervision of the pest control program. Guidance may be found in the Navy-wide Shipboard Pest Control Manual.

8-3. Specific Responsibilities of the Medical Department

a. Specifically, the medical department is responsible to the commanding officer for:

(1) Inspections and surveys to determine the species, source, location, and density of disease vectors and nuisance pests.

(2) Recommendations relating to sanitation standards and practices affecting the presence and abundance of pests and use of control methods.

(3) Evaluation of the effectiveness of control measures.

(4) Inspections and recommendations to ensure that pesticides are used safely following current directives.

(5) Provide information on all appropriate personal protective measures.

(6) Coordination with civilian and other governmental agencies having pest control problems that may affect naval personnel on or in the vicinity of a command.

(7) Compliance with all appropriate public health quarantine measures.

(8) Reviewing and approving activity pest management plans.

b. The medical department may also be charged by the commanding officer with the responsibility for all operational phases of the vector control program as follows:

(1) In the event of a vector-borne disease outbreak.

(2) In the absence of a public works department, such as at certain shore installations, onboard ships, and with troops in the field.

(3) In the control of vectors actually infesting humans (e.g., lice, mites).

(4) In disaster situations.

8-4. Location and Responsibilities of Navy Medical Entomologists

a. Operational Navy medical entomologists are assigned to Disease Vector Ecology and Control Centers (DVECC) at Naval Air Station (NAS), Jacksonville, Florida and Bangor, Washington. Medical entomologists are also assigned to the Navy Environmental and Preventive Medicine Units (NAVENPVNTMEDU) in Norfolk, VA (No. 2); San Diego, CA (No. 5); Pearl Harbor, HI (No. 6), and Sigonella, Italy (No. 7); to the Preventive Medicine Section 1st Force Service Support Group (FSSG), Camp Pendleton, CA; 2nd FSSG, Camp Lejeune, NC; and 3rd FSSG, Okinawa, Japan.

b. Navy medical entomologists assigned research responsibilities may also be assigned to the Naval Medical Research Units Jakarta, Indonesia (No. 2), Cairo, Egypt (No. 3), and Naval Medical Research Center, Lima, Peru.

c. Medical entomologists at DVECC and NAVENPVNTMEDU locations, when authorized by proper authority, may conduct vector control operations for the purpose of training personnel; field testing new methods, materials and equipment, or providing area-wide vector control services that involve the use of specialized equipment.

(1) The DVECC, NAS, Jacksonville, FL area of assignment includes all U.S. Navy activities 100W longitude east to 70E longitude.

(2) The DVECC, Bangor, WA area of assignment includes all U.S. Naval activities 100W longitude west to 70E longitude.

d. Functions of DVECC medical entomologists include:

(1) Survey ships, stations, and other pertinent operational areas for the purpose of recognizing, defining, preventing, or abating vector or ecological problems associated with pesticide use.

(2) Provide specialized area-wide operational services, which shall include identification of suspected entomological vectors of biological warfare agents and/or material for the control of vectors where accomplishment is normally beyond the scope of individual commands.

(3) Provide basic, advanced, and refresher training for military and civilian personnel in vector and economic pest prevention and control measures including integrated pest management strategies.

(4) Provide aid consistent with the mission, when authorized, in the event of civil emergencies or disasters including environmental contamination resulting from toxic pesticide spills.

(5) Provide review of requisitions for nonstandard and controlled issue economic pest and vector control items as established by current directives.

(6) Conduct field and laboratory evaluation and testing studies in vector prevention and control, including aerial and ground pesticide dispersal methods and ecological hazards or pesticide use, when authorized by BUMED.

(7) Maintain such liaison with governmental and civil agencies as necessary for mission accomplishment.

(8) Provide medical information to requesting commands on vector-borne disease occurrence worldwide.

(9) Provide or undertake such other appropriate functions as may be authorized or directed by higher authority.

e. Functions of NAVENPVNTMEDU medical entomologists, within the primary mission, are the same as those given for DVECC's subject to the limitations imposed by laboratory facilities and availability of funds.

f. Special operating units are available as functional components for advanced base use. Entomologists and preventive medicine technicians (PMT) are provided in the Navy advanced base organization.

g. The entomologist assigned to Defense Logistics Agency (DLA) provides specialized support in the area of stored products pest management.

8-5. Specific Responsibilities of Applied Biologists of the Naval Facilities Engineering Command

Specific responsibilities of applied biologists assigned to engineering field divisions of the Naval Facilities Engineering Command are delineated in OPNAVINST 6250.4 series.

8-6. Training and Additional Personnel

a. **Shipboard Pest Control**

(1) Scheduled training programs are available to shipboard pest control personnel. This training, as required by BUMEDINST 6250.12 series, Pesticide Applicator Training and Certification for Medical Personnel presents techniques and precautions necessary to safely apply pesticides aboard ship. The senior enlisted medical department representative and the corpsman responsible for pest control must attend shipboard pest control training once a year.

(2) Only medical department personnel successfully completing the course will be officially certified. Certified personnel are qualified to procure standard stock pesticides approved for use aboard ship and conduct shipboard pest control operations. Other personnel such as those in the supply and food service departments play an important role in a ship's pest control program. They are strongly encouraged to attend this training program.

b. **Pest Control at Shore Installations**

(1) In accordance with DOD Directive 4150.7, pesticide dispersal and other pest control operations must be performed by or under direct and continuing supervision of trained and certified personnel. Direct supervision includes being at the specific location where the work is conducted and maintaining line of sight view of the work performed. Direct supervision is required only during application of restricted-use or state limited use pesticides.

(2) Training and certification of all DOD personnel must follow the guidelines in DOD Publications 4150.7-M, DOD Pest Management Training and Certification and 4150.7-P, DOD Plan for the Certification of Pesticide Applicators.

(3) Training and certification of medical department personnel assigned responsibilities related to surveillance and control of arthropods and other vectors must also follow guidelines set forth in BUMEDINST 6250.12 series.

(4) Specialized vector and pest control training leading to DOD certification is available at both DVECC's. DVECC's and NAVENPVNTMEDU also provide training and certification of hospital corpsman in shipboard pest management as per BUMEDINST 6250.12 series.

8-7. Integrated Pest Control Programs and Pest Management

a. OPNAVINST 6250.4 series states that naval shore activities will cooperate with U.S. Federal, State, and local environmental protection agencies (EPA) and comply with the official standards and criteria promulgated by such agencies. Naval ships in foreign harbors and naval installations overseas will adhere to U.S. Federal EPA standards, and/or those of the host nation, whichever is more stringent.

b. Public concern over extensive use of long lasting pesticides and their possible effects on human health, wildlife resources, and other elements of the environment emphasizes the need for continuous professional review and training in the selection and application of pest control measures. The Department of the Navy will continue to support these standards and objectives fully by requiring that all pest control measures be performed under supervision of certified personnel using professionally approved pesticides and equipment.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION II. PESTICIDES AND THEIR APPLICATION

8-8. Definitions of Pesticides

a. A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest; or any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant.

b. Pesticides are used in many ways and include: acaricides, avicides, fungicides, herbicides, insecticides, molluscicides, nematocides, rodenticides, among others.

c. Fumigants are also pesticides and may function as any of the above depending upon the type of formulation, means of application, mode of action, target area, and pest species.

8-9. Department of Defense Standards

a. DOD components' pest management programs conform to the following requirements. Controlled pesticides are for use only by trained pesticide applicators and under the onsite supervision of a DOD certified applicator, or by specially trained site or shipboard medical department personnel. U.S. EPA restricted use pesticides may be procured and used only by certified pesticide applicators or by persons under their direct supervision.

b. Restricted and non-restricted use pesticides are procured through the military supply system. Where restricted or non-restricted use items do not provide satisfactory control, or when there is any doubt that available personnel are qualified to supervise the application of any pesticide, medical officers should request the help of specialists. Entomologists of the medical department and applied biologists of NAVFAC will provide services necessary to survey pest problems, outline control programs, train, and certify local personnel.

c. Nonstandard pesticides and dispersal equipment must not be used unless approved by the appropriate area entomologist following current instructions.

8-10. Classifications of Pesticides

Pesticides may be classified on the basis of use, life stage of the pest to be controlled, chemical group, mode of entry, mode of action, and formulation. Some pesticides are not easily categorized by standard methods because they can be used against two or more groups of pests or in formulations that may have two or more modes of entry or action.

a. **Pesticide Type by Use**

(1) **Acaricide.** Substance used to control mites, scorpions, spiders, ticks, and related organisms.

(2) **Fungicide.** Substance used to control fungi.

(3) **Herbicide.** Substance used to control undesired vegetation.

(4) **Insecticide.** Substance used to control insects, sometimes used in a broader sense to include the control of arthropods other

than insects. Classification of insecticides may be subdivided on the basis of the life stage against which they are used:

(a) **Adulticide.** Used to control the adult stage of an insect.

(b) **Larvicide.** Used to control the larval stage of an insect.

(c) **Ovicide.** Used against the egg stage of an insect.

(5) **Molluscicide.** Substance used to control snails and other mollusks.

(6) **Rodenticide.** Substance used to control rodents.

b. **Pesticide Type by Chemical Group**

(1) Inorganic pesticides are compounds of mineral origin and mainly include arsenic, copper, mercury, sulfur, or zinc.

(2) Chlorinated hydrocarbons are a group of synthetic organic compounds with one or more chlorine atoms. Chlordane, dieldrin, and dichloro-diphenyl trichloroethane (DDT) are examples.

(3) Organophosphates are synthetic compounds containing phosphorous. Some of the more common examples in this group are: diazinon, dichlorvos, and Malathion.

(4) Carbamates are synthetic compounds of salts or esters of carbamic acid. Carbaryl and propoxur are examples.

(5) Botanicals are pesticides of plant origin. Pyrethrums and rotenone are examples. Synthetic pyrethroids, such as resmethrin, are similar in action to pyrethrum. D-phenothrin is another example.

c. **Pesticide Type by Mode of Entry**

(1) Stomach poisons are materials, which kill following ingestion. Application may be directly to the pest's natural food, mixed with baits, or sprinkled in runways so pests will take the compound into the mouth when cleaning contaminated appendages.

(2) Contact poisons enter through the insect's body wall or respiratory centers and/or other tissue. They include residual surface sprays that kill pests coming in contact with the treated area and aerosols or space sprays that kill after contact with the body surface. Contact poisons may also act as a stomach poison if ingested.

(3) Fumigants are chemicals that enter in the gaseous or vapor form via the respiratory system and/or through body surfaces.

d. **Pesticide Type by Mode of Action**

(1) Biologicals are pesticide formulations containing parasitic microorganisms such as viruses, bacteria, fungi, protozoans, nematodes, or their metabolic by-products that control the pest.

(2) Desiccants are absorptive dusts, which scratch, absorb, or abrade the waxy surface of the exoskeleton causing death by dehydration. Silica gels are examples.

(3) Preservatives are normally poisonous substances applied to materials such as wood to protect from destructive pests.

(4) Repellents are compounds, which actively repel pests and, thus, deter attack.

(5) Chemosterilants are substances that chemically sterilize pests thus, reducing reproductive potential.

(6) Soil sterilants are normally thought of as an herbicide treatment to control unwanted vegetation in a given area for 6 months or more. Some sterilants are specific for soil dwelling animal species. Fumigants in this category are often used to control both plant and animal life.

(7) Systemics are compounds absorbed by and translocated throughout the host plant or animal to kill parasites sucking juice or body fluids, respectively. Herbicides may be systemic and kill the treated plant (root and aerial).

(8) Growth regulators are synthetic hormone-like compounds that prevent normal growth of and/or maturity of the target plant or animal species.

8-11. Pesticide Formulations and Dispersal

a. **General.** Few pesticides are used in the originally produced concentrated forms. Most of these compounds must be specially formulated to permit adequate and effective application. Formulations are prepared from the highest concentrated (technical-grade) form of the pesticide and may contain auxiliary carrier or dispersal compounds such as emulsifiers, solvents, or other special additives. Virtually all preparation of concentrated material for military use is done commercially. Dilution of the concentrate with oil or water is all that is normally required. Dry dusts or granules are usually prepared in a ready-to-use form and require no further processing.

b. **Formulation Selection.** Selection of the proper formulation for a specific control measure is as important as the choice of pesticide. The various formulations into which pesticides may be prepared are:

(1) **Oil Solutions.** Oil solutions consist of the toxicant mixed into a petroleum-based diluent. They are effective for penetrating cracks and crevices. They may be used around electrical equipment or power distribution panels, but the oil must not contact the wiring or insulation because of its solvent properties. These solutions may be used where dampness or water cause problems or where there is a need to apply insecticides in cold weather. Oil solutions are also applied as space aerosols or sprays either indoors or outdoors for knockdown or kill of insects. Space sprays are effective against flying insects only while the particles remain suspended in the air. Droplets that settle from spray applications may be effective as short-time residuals depending upon their particle size and insecticide characteristics. It must be remembered that oil solutions are phytotoxic and care must be taken when using them around desired vegetation. Oil solutions cannot be exposed to high temperatures or open flames, and their solvent action precludes their application to some synthetic substances (e.g., composition, fabric or plastic materials). Oil solutions are generally more readily absorbed through the skin and also more odorous than other kinds of preparations.

(2) **Emulsions.** An emulsion consists of droplets of an emulsifiable pesticide dispersed in a diluent in such a way as to prevent separation of the two components. The emulsifiable concentrate is a preparation of the toxicant, a solvent and the emulsifier, which is often some form of detergent. Emulsifiable concentrates are almost always diluted with water, but can be diluted with oil to form an oil solution. "Breaking," the gradual separation of the water and other ingredients, occurs with time so the preparation must be used when freshly mixed. Occasional agitation may be necessary during use. Emulsions can be used on synthetic organic materials around heat or open flames and with care on vegetation.

(3) **Suspensions.** Suspensions are generally mixtures of wettable powder with water. The wettable powder consists of a mineral base impregnated with the pesticide plus agents to "wet" and suspend the powder in

water. Suspensions must be used with machines that provide constant agitation. Suspensions dispersed by a portable compressed sprayer also require frequent agitation. Suspensions are employed as foliage/grass sprays for application against turf pests as residuals against some stored products pests and for interior residuals in malaria control programs.

(4) **Dusts.** A "Dust" pesticide formulation is a mixture of a toxicant plus an inert base usually consisting of a finely ground form of bentonite, pyrophyllite, or talc. These mixtures are used as indoor and outdoor residuals and for animal applications.

(5) **Granules/Pellets.** Granules or pellets are preparations of pesticide impregnated into particles of highly absorptive clays and earths, which are graded by sizes ranging from coarse pebble-like pellets to those with a consistency of fine sand. Granules and pellets with greater particle weight have a minimized drift, thus, preventing undesirable contamination of areas bordering those being treated. The most useful size range is from 15 to 40 mesh. An important use of granules for vector control is in mosquito larviciding where penetration of foliage and adequate deposit in water is desired. Large turbine-type dusters, backpack units, hand-carried dust dispensers and portable seeders can apply granules. Special aerial dispersal units may also be employed for large area treatment.

(6) **Other Pesticides.** This miscellaneous grouping includes the application of pesticides by brush or roller, as a paste, grease, or cream, or as solid formulations, which vaporize slowly in air. Some solid formulations of pesticide compounds are used as baits.

c. **Additives.** Pesticide additives are materials that enhance the effectiveness of basic toxicant chemicals by altering their physical or chemical characteristics. The manufacturer usually adds some additives, such as solvents and emulsifiers, to the basic active ingredient at the time of production. Pest control personnel before application of the pesticide may add other additives, such as adhesives and diluents, to the formulation. Commonly used pesticide additives are:

(1) **Adhesive (sticker).** Material used to cause pesticide adherence to a surface such as a plant leaf.

(2) **Attractant.** Substance used to attract pests to pesticides or traps.

(3) **Diluent, Carrier.** Dry or liquid material added to a pesticide to facilitate formulation and/or distribution.

(4) **Emulsifier.** Material added to a pesticide formulation to produce an emulsion when the carrier solution is added. Some pesticide concentrates contain emulsifiers so that only the addition of water is needed.

(5) **Fluidizer.** Material used with dust; a formulation to prevent caking and permit the dust to flow easily during application.

(6) **Masking agent, Deodorant, Perfume.** Material used to remove or mask any unpleasant odor of a pesticide.

(7) **Solvent.** Material used to dissolve a pesticide for the preparation of a liquid formulation.

(8) **Spreader, Wetting Agent.** Material, which reduces surface tension and, thereby, enhances spread of a solution or emulsion over a surface.

(9) **Synergist.** Material which, when added to a pesticide, increases the effectiveness of that pesticide. A pesticide with a synergist has a sum total effect greater than that of the pesticide or synergist alone.

d. **Pesticide Dispersal.** After the desired formulations have been selected, prepared, and procured, they may be dispersed in the following forms:

(1) **Gases and Vapors.** The dispersal of gases and vapors is termed fumigation. They must be handled with great care and only under direct supervision of specially trained and certified personnel. Gases and vapors are able to penetrate packaged commodities, clothing and structures, which are inaccessible to treatment by other dispersal methods. Because they lack residual properties, fumigants are used when other formulations are ineffective or because of penetration requirements. However, because of their physical properties, fumigants can be used only in airtight spaces, which prevent dissipation. One type of fumigation, known as "vaporization," is accomplished by the use of solids such as paradichlorobenzene (PDB), which at room temperatures, passes from a solid directly into a vapor (sublimation).

(2) **Aerosols.** Aerosols are defined as a suspension of liquid or solid particles in air where the particle size generally ranges from 0.1 to 50 microns in diameter with 80% of the particles in the 0.1 to 30 micron range. Liquid particles make up a fog and solid particles form a smoke. Insecticide aerosols are frequently dispensed from hand held pressurized containers or larger ultra low volume (ULV) dispersal equipment.

(3) **Mists.** Mists are dispersed particles in which the particles are intermediate in size between those of aerosols and fine sprays. Droplets in the 50 to 100 micron size range are considered to be mists. They are less effective than aerosols for outside space treatment, but they are adaptable for larviciding in areas accessible to vehicles and for large scale residual spraying of vegetation. Because of their larger size, mists can be used under a wider range of weather conditions than can aerosols, and their residual effect is greater.

(4) **Sprays.** (The most commonly used formulation.)

(a) **Fine sprays.** Fine spray droplets are considered to be from 100 to 400 microns in diameter. Droplets within this range remain airborne short periods of time and settle rapidly. Sprays of this type are frequently used as mosquito larvicides and for residuals.

(b) **Coarse sprays.** These sprays consist of droplets over 400 microns in diameter and are applied evenly to wet a surface. Coarse sprays are frequently employed when using herbicides and when applying heavy residuals of insecticide to fly breeding areas.

8-12. Application of Pesticides

a. **Effects of Particle Size.** Efficient application of pesticides requires the dispersal of the proper particle size for the type of application desired. The residual quality of many insecticides makes it possible to kill by contact long after the material has been applied to walls, vegetation or other insect resting places. In order to take full advantage of the residual characteristics of a pesticide, it should be applied only in the form of a coarse spray or dust. By contrast, efficient use of space sprays calls for their dispersal in much smaller particles. Coarse sprays are inefficient aerosols because the fewer number of droplets decreases the chances of target contact. Those particles, which do contact the target, may contain many times the amount of insecticide needed to affect a kill. Large particles fall to the ground while small particles may remain airborne for extended periods of time, providing more opportunity to contact targets. In this respect there is also a disadvantage in that unfavorable air current or high wind velocity may cause rapid dispersal of the droplets into the atmosphere, and the small insecticide particles may be transported to non-target areas. Under favorable conditions, aerosols or fogs are quite efficient for killing insects or other arthropods by means of space treatment.

b. **Effect of Meteorological Conditions.** There are many conditions, which may improve or reduce the effectiveness of the pest control program. In addition to knowledge of the life history of the pest to be controlled, the proper choice of control technique, pesticide, and dispersal equipment, it must be remembered that meteorological conditions such as convection, relative humidity, wind velocity and direction, and temperature may add to the complexity of outdoor space spray operations.

(1) **Convection.** Once the pesticide is released from the nozzle, meteorological conditions are the only forces acting upon the particles. One of the most important of these is convection, or the upward and downward movement of a limited portion of the atmosphere. Convection influences the deposition of particles on the surface of the ground, foliage or target pest according to the existing temperature conditions. When the ground temperature is at least one degree cooler than surrounding air (inversion), aerosol droplets tend to drift near the ground within the habitat where the target species is most likely to be contacted. Coverage of the area will generally depend on the wind conditions at the time. When the ground temperature is warmer than the air (lapse condition), small droplets in the mist and aerosol range, tend to be carried up and out of the target zone by convection currents. Measurements of temperature to determine inversion or lapse conditions may be accomplished by using thermometers placed 0.3 and 1.8 m (1 and 6 ft) above the ground.

(2) **Wind.** A fine spray or dust will be scattered over a very wide area during a high wind especially under lapse temperature conditions. On the other hand, a lack of air movement will limit the pesticide distribution. Normally, it is an advantage to conduct outdoor space dispersal of aerosols if the movement of air is about 1 to 7 knots in a direction perpendicular to the line of dispersal (discharge from nozzle) and toward the area to be treated.

(3) **Temperature.** Some pesticides may be more effective when air temperatures are 21 degrees C. (70 degrees F.) or above while others are more effective at lower temperatures. Pesticide labels can provide information regarding the influence of temperature on control.

c. **Selection of Method.** Before a control operation is undertaken, one must determine if chemical control of the pest is the most satisfactory approach. Chemical control is the most expensive yet least permanent of the various methods of pest control. It should only supplement, not replace other pest control procedures. However, there are many situations where pesticides are valuable tools in the pest control program, such as during the threat of outbreak of vector-borne disease. Even during such times, control personnel should not lose sight of long range and more permanent measures.

(1) **Preventive Control.** Quarantine, drainage, impoundment, flushing, flooding, ditching, screening, sanitation, etc., are basic practices in the prevention of pest infestations. These methods of control are expensive initially but are the least costly and most effective over a long period of time. When military bases are of a permanent type, these methods are preferred.

(2) **Chemical Control.** To employ chemical control measures is to admit the preventive measures are not adequate. This method of pest control is the most common and expensive, and it is temporary at best. In most field operations, when the site is to be occupied for short periods of time, chemical controls are used almost exclusively. Corrective controls are used until preventive controls are established and then only to augment more desirable methods of pest control. However, under combat conditions, chemical control may be the method of choice because of the need to rapidly reduce the vector population and because permanent control measures may be impossible due to lack of security.

8-13. Resistance to Pesticides

a. **Definition of Pesticide Resistance.** Resistance of pests to pesticides is defined as the ability of a given population to withstand a poison that was effectively lethal to earlier generations of the species.

b. **Development of Resistance.** Most normal populations of animal species include individuals that vary in their susceptibility to pesticides. Consequently, candidate pesticides will kill some individuals of a species more readily than others. Individuals in a population that are less susceptible to a chemical are considered to be more resistant. Continued pesticide pressure upon a population will destroy the most susceptible individuals, permitting the more resistant individuals to survive and produce generations of increasingly resistant offspring. Thus, the species becomes increasingly difficult to control because of genetic factors transmissible to subsequent generations. Development of resistance in a pest population can be subtle or quite dramatic. Houseflies were found to develop resistance to DDT within a year after it was introduced into areas of Europe. For mosquito control, the use of the same insecticide as a larvicide and adulticide is thought to enhance the development of resistance. Resistance is not confined to insecticides, nor is it always rapid in development. Some Norway and roof rats and house mice have become resistant to anticoagulant rodenticides in Europe and the U.S. after 20 years of use. Pesticide resistance has been reported for more than 225 species of arthropods. All of the modern day insecticide groups that include organophosphates, organochlorines, and carbamates have examples of the development of resistance. Even cross-resistance between these groups occurs. For example, chlordane (organochlorine) resistance may increase propoxur (carbamate) resistance in the German cockroach, Blatella germanica. This condition further complicates the situation for control work and necessitates reliance on specialists for recommending changes in methods, materials, and dosage rates. Not all field reports of resistance are valid. Other factors may be responsible for unsatisfactory control. Faulty techniques, chemical agents and equipment, inexperienced or incompetent operators, increased breeding rates, migration from outside the controlled area, and poor sanitation are a few of the more frequently observed reasons for ineffective control. It must be continually emphasized that change to another insecticide should be considered only when conclusive laboratory proof of resistance is obtained. The question of whether a resistant strain will revert to susceptibility when not exposed to the pesticide for a period of time has not been completely answered. The consensus among researchers is that while reversion will probably occur if there is no further exposure to the same or related pesticides, the time required would be dependent upon the degree of resistance developed. However, it has been experimentally demonstrated that once a resistant insect species has reverted back to susceptibility that resistance may quickly reappear with resumed use of the original insecticide.

c. **Prevention of Resistance.** Selection of an insect population for insecticide resistance may be averted or delayed by rotating the different classes of insecticides available for control. For example, treating a German cockroach population repeatedly with an organophosphate insecticide may hasten the development of resistance to this class of insecticides. The use of integrated pest management techniques which include preventive, exclusion, biological, physical as well as chemical control methodologies together in a comprehensive pest control strategy will also help to slow or stop the development of resistance.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION III. PESTICIDES HAZARDS AND USE RESTRICTIONS

8-14. General

The information and directions on the pesticide label are important to every user. When properly followed, the directions provide maximal protection for applicators, consumers, and non-target organisms. The label directions discuss the chemical hazards, registered uses, recommended doses, compatibility, phytotoxicity, and legal restrictions. Read all pesticide labels prior to use. Use of pesticides in a manner inconsistent with the label is a violation of Federal law.

8-15. Assessment of Pesticide Hazards

a. When selecting a pesticide for a control program, consideration must include the possible hazards to life other than the pests to be controlled since pesticides may be toxic to other living organisms. All pesticides should be considered potentially harmful to humans to some degree, therefore basic precautions must be practiced. No matter what material is used, it is standard procedure to protect food, cooking utensils, food preparation surfaces, and to avoid continued human exposure to pesticides.

b. When assessing the hazards of any particular pesticide, each of the following factors must be carefully considered and evaluated:

(1) Oral and inhalation toxicity.

(2) Effect on the skin.

(3) Accumulative effect on body organs.

(4) Effect of prolonged exposure to small dosages.

(5) Composition of the formulated pesticide.

(6) Concentration of toxicants used.

(7) Rate of deposit required for control.

(8) Frequency of pesticide application.

(9) Degree of exposure to pesticide residues.

(10) Physical and chemical properties of the agent.

c. Continual awareness of hazards associated with pesticide handling and use, and careful attention to safeguards make it possible to use all standard military pesticides with a minimum of risk.

8-16. Toxicity of Pesticides

a. Pesticides are toxic to humans and domesticated and wild animals in varying degrees and must be used with care. Toxicity varies with the chemical nature of each pesticide and may be rated subjectively as having low, moderate, or high toxicities. Even though a pesticide may have a low toxicity rating, it may still be injurious, or even fatal, depending on the formulation, concentration at exposure, duration of exposure, and the body weight and general health of the person exposed. Data on chronic effects of pesticides on man are limited. The dose exposure required to produce acute poisoning is not applicable for predicting dosages producing sub-acute and chronic effects.

b. **Toxicity Ratings.** A wide range of toxicity values for many of the pesticides has been reported. The values are expressed as acute oral or dermal lethal dose = 50 percent (LD50) in terms of milligrams (mg) of active ingredient ingested or contacted per kilogram (kg) of body weight of the susceptible animal. Respiratory doses are expressed in lethal concentrations (LC50) that will kill 50 percent of the exposed animals. No tests have been conducted in which humans have been subjected to lethal doses of pesticides. However, the effects of some chemicals on humans have been obtained from reports of accidental exposure or suicides. Information from these reports is frequently incomplete; consequently, evaluation of this type of data for estimating human toxicity of pesticides must be done with caution.

c. The data on acute oral toxicity divide insecticides into four groups (see Table 8-1 below). These groupings have considerable practical value because packaging labels must include key signal words (e.g., DANGER, POISON, WARNING, and CAUTION), and if applicable, antidotes and other necessary precautions.

Table 8-1. Criteria for Cataloging Pesticides by Toxicity, and Label Requirements Established by the Amended Federal Insecticide, Fungicide and Rodenticide Act of 1972

Signal Word and Antidote Statement	Toxicity and Acute Oral LD50 Value	Approximate Amount Needed to Kill the Average Person
I. "DANGER," "POISON," Skull and Crossbones *Antidote Statement, "Call Physician Immediately"*	Highly Toxic 0-50 mg/kg	A taste to a teaspoonful
II. "WARNING" *No antidote statement*	Moderately Toxic 50-500 mg/kg	A teaspoonful to a tablespoonful
III. "CAUTION" *No antidote statement*	Slightly Toxic 500-5000 mg/kg	An ounce to more than a pint
IV. *No Warning, Caution, or Antidote Statement* Unqualified claims of safety are not acceptable	Comparatively free 5000 + mg/kg	More than a pint

Note. All pesticide products bear the words "Keep out of reach of Children."

8-17. Insecticide Hazards and Use Restrictions

a. **General.** Insecticides, formulated as solids or wettable powders and dusts, pose less of a hazard by dermal poisoning than when in solutions. However, dusts and powders are easily inhaled and consequently produce a greater respiratory hazard.

b. **Stomach Poisons.** Most of the substances used in stomach poisons to control insects are also toxic to man and animals. Although some are more toxic than others, each must be handled with care and used only in the amounts recommended for the specific pest. Stomach poisons are not to be used in any manner that is inconsistent with the directions on the label. These materials are not to be used in bodies of water due to toxicity to aquatic life, on food contact surfaces, or on plants used for food or forage. The drift of spray droplets must be avoided to eliminate contamination of non-target areas. Contact with treated surfaces is not to be allowed until the spray has completely dried.

c. **Contact Poisons.** Substances used for initial or residual contact pest control (diazinon, propoxur) are all relatively toxic to man and animals. The degree of toxicity is related to the chemical and also to the type of formulation.

(1) **Hazards.** Many pesticides within this group are manufactured and marketed as a concentrate. Care must be exercised in handling, mixing, and using all contact poisons to avoid accidental inhalation, ingestion, or contact with the skin or eyes.

(2) **Use Restrictions of Contact Poisons**

(a) **Indoors.** Residual pesticides within this group that have EPA registration for use in food preparation areas are limited to crack and crevice treatment. Do not use these materials in occupied spaces and do not permit entry to an area prior to proper ventilation. Small amounts of these chemicals are applied directly into natural and construction cracks and crevices, between equipment bases and floors, into wall voids, motor housings, junction or switch boxes, conduits or hollow equipment legs, and any other place where pests may hide. In nonfood areas these pesticides may be applied by spray or brush to floors, walls, ceilings, or other infested areas. Overall treatment of interior surfaces of occupied spaces is prohibited. No person or pet should be allowed to contact treated surfaces until the liquid residual dries.

(b) **Outdoors.** Do not allow contact poisons to enter any body of water directly or as runoff because of their toxicity to aquatic life. Do not use these chemicals on food or forage plants or on animals in a manner other than that recommended on the label. Avoid drift of the sprays or dusts and keep domestic animals from contact with wet treated surfaces. Restrict application of these pesticides to infested areas.

8-18. Rodenticide Hazards and Use Restrictions

a. **General.** If bait stations are accessible to children, pets, or domestic animals, they must be kept in tamper-proof boxes. Baits should be picked up and disposed of upon completion of the control program. Foodstuffs such as candy and cookies must not be used as baits to avoid attracting children and pets. Bait stations should be checked monthly, unless rodent activity is noted; then they should be checked at least weekly.

b. **Anticoagulant Baits.** All normal pesticide precautions apply when handling single or multiple dose anticoagulant materials.

8-19. Fumigant Hazards and Use Restrictions

a. **Relatively Nontoxic Fumigants.** A chemical such as naphthalene is relatively safe to use. However, prolonged inhalation of the vapors is harmful. They should not be used near open flames.

b. **Extremely Toxic Fumigants.** Fumigants such as aluminum phosphide (hydrogen phosphide), sulfuryl fluoride, and hydrogen cyanide are to be used only by trained and certified personnel. Do not use these agents without proper review and approval of a medical entomologist or applied biologist.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION IV. PRECAUTIONS IN HANDLING PESTICIDES

8-20. General

The precautions listed in this section will enable individuals to use, store, mix, and dispose of pesticides and rinse solutions in a manner safe to themselves, other personnel and the environment. The user of pesticides is charged with the responsibility of knowing and complying with current EPA regulations and Navy standards.

8-21. Personal Protective Equipment

a. Personal protective equipment and clothing must be worn to protect all parts of the body from pesticide contamination and must be stored in an area separate from any pesticide exposure. Always read the pesticide label for recommendations on the use of protective clothing and devices.

b. **Respiratory Protective Devices**

(1) Wearing a National Institute of Occupational Safety and Health (NIOSH) approved respiratory device is necessary any time inhalation of pesticides can occur. Wearing a respirator does ***not*** replace the need for protective clothing on other parts of the body.

(2) Specific types of cartridges and canisters protect against specific gases and vapors. For low concentrations of insecticide sprays, dusts, mists, and vapors, use an approved respirator with organic vapor cartridge.

(3) Check the respirator's flutter valve to assure proper functioning.

(4) Respirator cartridges should be changed after 8 hours of use or sooner if pesticide odor is detected. During heavy spraying, change the respirator filters every 4 hours. After use, remove the filters and cartridges, wash the face piece with soap and water, rinse and dry it with a clean cloth, and store it in a clean, dry place, preferably in a tightly closed paper or plastic bag away from pesticides and pesticide equipment.

(5) Specially designed gas masks should be worn when working with toxic pesticides in close or poorly ventilated spaces. Fumigation requires special consideration. Contact the fumigant manufacturer or area entomologists for specific instructions.

c. **Eye Protection.** Wear either unvented or indirect vented goggles or a face shield to prevent contamination of the eyes with pesticides. After use, wash the goggles with soap and water, rinse and dry with clean cloth, and store with the respirator.

d. **Body Protection.** A long sleeve shirt and full-length trousers or coverall type garment (all of closely woven fabric) should be worn any time that pesticides are handled.

(1) A lightweight raincoat or rubber apron should be worn when handling pesticide concentrates or very toxic materials.

(2) Trousers should be worn outside of lightweight rubber boots to prevent pesticides from getting inside the boots.

(3) A clean set of clothing should be worn daily. If fabrics get wet during operation, change immediately. Wash contaminated clothing separate from other clothing. Do not take protective clothing home to be laundered. Laundering facilities should be provided.

e. **Head Protection.** Always wear something to protect the head. Pest control operators usually wear hard hats. When there is a possibility of drift, wear a wide brimmed, waterproof hat to protect neck, eyes, mouth, and face.

f. **Hand Protection.** When handling concentrated or highly toxic pesticide, wear liquid-proof, solvent resistant gloves (e.g., rubber, neoprene, or nitrile). They should be long enough to protect the wrist. Gloves should not be fabric lined since this is hard to clean if contaminated. Never use gloves of an absorbent material because they do not provide adequate protection. Garment sleeves should be positioned outside of the gloves to keep pesticides from running into the gloves. Wash gloves daily and test for leaks by filling them with water and gently squeezing.

g. **Ear Protection.** Ear protection is important during use of large pesticide dispersal equipment. Earmuffs provide maximum sound protection. It is extremely important that ear protective devices, whether plugs or muffs, be cleaned after use.

8-22. Pesticide Formulation, Storage, Fire Protection, and Transportation

a. Formulation of pesticides must be done in areas separate from office and locker spaces. Formulation areas should be equipped with a ventilation hood, adequate lighting, and washing and shower facilities.

(1) The pesticide handling area must be able to contain spilled pesticides and rinse solutions to prevent environmental contamination.

(2) Put on the correct protective equipment and clothing before handling any pesticide container.

(3) Carefully read the entire label each time before removing the pesticide from the container. This precaution is necessary since formulation directions are frequently changed.

(4) Always formulate in the specially designed area and keep the pesticide container below eye level to avoid a splash or spill on goggles. Use a sharp tool to open paper containers. Do not tear them open.

(5) Use only the amount specified on the label.

(6) Post written safety procedures to be followed in the case of pesticide spills. These procedures should include the medical department's telephone number and the location of decontamination materials.

(7) If the user becomes contaminated with pesticide, stop immediately and remove the contaminated clothing. Wash the exposed area thoroughly with soap and water. Speed is important because of the rapid absorption rate of pesticides by the body (15 minutes or less).

(8) After use, replace all pour caps and reseal bags and other containers to prevent spills and cross contamination.

b. Read the label on each pesticide container for correct storage procedure. Fumigants require additional storage safety precautions.

(1) In addition to posted procedures for handling pesticide spills, maintain a current listing of all pesticides in storage and keep it readily available for emergency use. This list should also be maintained as an appendix to the activity pest management plan with a copy filed with the activity's medical and fire departments. The list should include the following information:

(a) Manufacturer or distributor.

(b) Chemical name or group (e.g., organophosphate).

(c) Concentration.

(d) Type of formulation (e.g., oil solution, dust).

(e) Toxicity.

(f) Quantity.

(g) Flashpoint.

(h) Type of container (e.g., glass, drum).

(i) Common or brand name of pesticide.

(j) EPA registration number.

(2) Storage areas should have washing and firefighting capabilities and provisions to contain spills and decontaminate the area.

(3) The medical department should be informed of the potential for pesticide poisoning so that proper antidotes are available. The medical department, and/or emergency room of the medical treatment facility, should have a copy of the emergency pesticide poisoning wall chart prominently displayed and should maintain antidotes for highly toxic pesticides.

(4) Security personnel should also be informed of the hazards in pesticide storage areas.

(5) As soon as pesticides are delivered, mark the date of receipt on the container. Store in a locked and posted facility away from unauthorized individuals. Keep storage entrances locked when trained personnel are not present.

(6) Storage areas must allow the pesticides to be kept dry, cool, and out of direct sunlight to avoid deterioration. They should be insulated to prevent the chemicals from freezing or exposure to temperatures in excess of 100 degrees F.

(7) Storage areas should be of fire resistant construction with a concrete floor and good lighting. Provide an exhaust air ventilation system that provides at least six fresh air changes per hour. This ventilation system need only operate when the storage and formulation areas are occupied. The light and exhaust switch with a pilot light shall be located outside the door and marked with a sign reading, "OPERATE VENTILATION SYSTEM DURING OCCUPANCY."

(8) Storage areas should be liquid tight with a raised sill or a floor at least 10.2 cm (4 in) below the surrounding floor. Openings must have approved self-closing fire doors.

(a) A clear aisle of at least 0.9 m (3 ft) shall be maintained.

(b) Containers of flammable or combustible material over 114 L (30 gal) in size shall not be stacked upon each other. Dispensing shall be by pump or self-closing faucet devices bearing manufacturer's laboratory tested approval.

(c) Storage areas shall have safe, clearly marked exits that are unobstructed at all times.

(9) Do not store fertilizers and pesticides in the same building because of a difference in applicable fire control methods.

(10) Store all pesticides in the original containers where the label is plainly visible. Never put pesticides in another container unless the original has deteriorated. If repackaging is necessary, ensure identical labeling of the new container. Dispose of deteriorated containers properly (article 8-24).

(11) Never store herbicides with other classes of pesticides. Pesticides contaminated by volatile herbicides can cause unintentional damage to lawns and plants. Also, periodically check all pesticide containers for leaks or breaks and clean up any spilled material from damaged containers and repackage the contents.

c. **Fire protection in the shop area** generally can be accomplished with portable fire extinguishers. Contact the fire department for assistance.

(1) Smoking is ***never*** permitted in a pesticide handling area. Appropriate warning signs should be posted and enforced.

(2) It is important to inventory the amounts and types of flammable and combustible liquids in each area. Combustible liquids are those with flash points greater than 37.8 degrees C (100 degrees F) and flammable liquids are those with flash points below 37.8 degrees C (100 degrees F). These liquids must be stored in proper containers. Cases, boxes, or proper shelving must protect breakable containers.

(3) In pest control shops the potential for either class A, B, or C fire exists. Therefore, it is recommended that pesticide storage and formulation areas have multi-rated fire extinguishers.

(4) The number of fire extinguishers needed to protect a shop is based on several factors. Usually at least one in the storage/ mixing area and one in the general shop area are sufficient. The maximum allowable distance permitted for travel to an accessible fire extinguisher for flammable liquids is approximately 15 meters (50 ft).

(5) Fire extinguishers shall be conspicuously marked and located where they will be readily observed and immediately available for use.

(6) Special fire hazards created by pesticides include toxic fumes from volatized chemicals, accidental contamination of firemen, potential explosion of combustible pesticides and/or their solvents, and environmental contamination from runoff water if used for fire control.

d. **Transportation of Pesticides**

(1) The user of pesticides is legally responsible for their safe transportation after purchase and possession.

(2) Carry pesticides in the back of a truck, never in the cab. They should be securely fastened, enclosed, and locked to prevent spillage and contamination of personnel and equipment. Vans should be prohibited from use as pest control vehicles.

(3) Special precautions should be allowed for paper containers to protect them from moisture damage.

(4) Signs should be secured properly on the vehicle to warn of the potential hazard.

(5) If any pesticide is spilled in or from the vehicle, clean up the spillage as discussed in article 8-23 below.

(6) Pest control vehicles must carry a small spill clean-up kit and a container of eye wash solution.

8-23. Decontamination of Equipment and Pesticide Spills

a. Decontamination is ***removal*** of the toxicant to a disposal area. It is ***not neutralization***. Pesticide spill kits should be located at every pesticide storage facility. Refer to Armed Forces Pest Management Board Technical Guide No.15, Pesticide Spill Prevention and Management for additional information.

b. The amount of cleaning solution used for decontamination should be kept to a minimum because it must be disposed of in the same manner as waste pesticides.

c. The first step in decontamination of an area or piece of equipment from a minor spill is to confine the pesticide. If the chemical starts to spread, contain it with dikes of sand or dirt. For dry pesticide spills, clean up the agent and treat the contaminated surface as directed in article 8-23f and 8-23g below.

d. Use an absorbent material, such as fine sawdust or other specially designed material, to soak up the spilled liquid pesticide.

e. Shovel all of this contaminated material into a leak-proof barrel for disposal.

f. Do not flush the contaminated area. Treat contaminated surfaces with detergent and water or chlorine bleach. The latter solution may be used on all groups of pesticides except organochlorines. With a long handled broom and decontamination solution, thoroughly scrub the exposed surface.

g. Soak up the decontamination solution with absorbent material and place it in a leak-proof barrel for disposal.

h. Repeat the washing and collection procedure of steps in article 8-23f and 8-23g above until all of the pesticide is removed.

i. For major spills follow the same procedure, and then call the medical department, base environmental, or area entomologist for specific instructions and assistance.

j. If a major spill occurs on a highway, have someone notify the highway patrol or local sheriff. Do not leave the area until responsible assistance arrives and have been appraised of the dangers involved.

k. All movable equipment used for handling pesticides and pesticide containers should be designated as pest control equipment and should not be removed from the working areas unless thoroughly decontaminated.

(1) Appropriate protective clothing should be worn during the machine cleaning process.

(2) Clean equipment with detergent and water solution or spray lime [1.4 kg (3 lbs.) in 18.9 L (5 gal) of water]. Dispose of cleaning and rinse solution in a sanitary sewer system according to EPA regulations where legal.

8-24. Pesticide and Container Disposal

a. Pesticides should be disposed of only if the products are contaminated, outdated, no longer needed, or cannot be used at another activity.

b. Contact your regional Defense Reutilization and Marketing Office of the DLA for specific details on pesticide disposal.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION V. FIRST AID AND EMERGENCY TREATMENT FOR PESTICIDE EXPOSURE

8-25. General Procedures

a. Strict adherence to basic principles in rendering first aid to victims of pesticide contamination and poisoning may avert disfigurement, compromise of health, and possibly loss of life. A chart, Emergency Medical Treatment for Acute Pesticide Poisoning, available from any DVECC or NAVENPVNTMEDU, should be posted in conspicuous places where pesticides are stored, issued, mixed, or handled and in emergency rooms of medical treatment facilities.

b. Decontamination is extremely important in pesticide poisoning and should be done as quickly as possible. When properly accomplished according to the nature of exposure, decontamination terminates exposure and, thereby, limits the dose.

c. It is important that the pesticide container, a sample of the remaining residue, and a readable label or the names of the chemical constituents be saved for use by the medical officer.

d. Supportive therapy does not counteract the specific toxic action of the pesticide, but assists in maintaining vital body functions. The purpose of supportive therapy is to keep the patient alive until specific antidotes can be given and take effect, or until the body has sufficient time to metabolize and detoxify the poison. Supportive therapy includes the following:

(1) Cardiopulmonary resuscitation.

(2) Artificial respiration (mouth to mouth if oral intake of the pesticide is not involved).

(3) Maintenance of a free airway.

(4) Oxygen therapy for cyanosis.

(5) Postural drainage.

e. A nation-wide network of poison control centers (PCC) has been established in conjunction with the Public Health Service (PHS). These centers are usually located in local hospitals and are geographically located to be available by telephone from almost every part of the country. Their staff members are specially trained for the treatment of poison cases. When requiring information and assistance, dial the number given for the PCC in the nearest city. Also, ask the operator for the name of the person who is in charge. This will eliminate unnecessary delay and possible misunderstanding.

8-26. First Aid For Pesticide Contamination

a. **Eye Contamination**

(1) Holding the lids apart, wash the eye for 5 minutes with a gentle stream of running water.

(2) Do not use chemical antidotes because they may increase the extent of injury.

b. **Skin Contamination**

(1) Flood the skin with water.

(2) Direct a stream of water onto the contaminated area while removing the patient's clothing.

(3) Do not use chemical antidotes.

8-27. First Aid For Internal Poisoning From Pesticides

In the event of internal pesticide poisoning, render first aid as follows:

a. When possible obtain immediate, on-the-spot services of a physician. If this is not possible, administer the antidote recommended on the label of the pesticide container, then rush the victim to the nearest medical facility. Never attempt to administer an oral antidote to an unconscious victim.

b. In the event no specific antidote is recommended on the label of the pesticide container, administer the treatment as recommended on the "Emergency Medical Treatment for Acute Pesticide Poisoning Chart" until the services of a physician are available.

c. If the victim is cold, cover him/her with a light blanket. To avoid burns, hot objects should not be used to warm the patient.

d. In the event the victim stops breathing or breathing becomes difficult, administer the appropriate artificial respiration.

8-28. First Aid For Poisoning By Fumigants

In the event of poisoning by toxic gases, render first aid as follows:

a. Quickly move the victim to a source of fresh air (outdoors if possible).

b. Call a physician promptly, or rush the victim to the nearest medical facility.

c. Remove contaminated clothing, but keep the patient warm.

d. If the prompt services of a physician are not available, administer the antidote recommended on the label of the fumigant container.

e. In the event the victim stops breathing, or if breathing becomes difficult, administer mouth-to-mouth artificial respiration.

8-29. Organophosphorus Pesticide Poisoning and Suggestions For Treatment

Organophosphorus pesticides cause irreversible cholinesterase inhibition. Examples include: chlorpyrifos, diazinon, dichlorvos, malathion, and naled.

a. **Signs and Symptoms**

(1) **Mild.** Headache, dizziness, weakness, anxiety, pupillary contraction, blurred vision, and nausea.

(2) **Moderate.** Nausea, salivation, lacrimation, abdominal cramps, diarrhea, vomiting, sweating, slow pulse, muscular tremors, and respiratory compromise.

(3) **Severe.** Respiratory difficulty, pinpoint and non-reactive pupils, pulmonary edema, cyanosis, loss of sphincter control, muscle spasms, convulsion, coma, and eventual death due to respiratory failure.

b. **Antidote**

(1) **Adults.** After cyanosis is overcome, give 2 to 4 mg of atropine sulfate intravenously (IV). Repeat doses at 5 to 10 minute intervals until signs of atropinization appear. Maintain treatment for 24 hours or longer if necessary. A total of 25 to 50 mg or more may be necessary during the first day.

(2) **Children.** Give atropine sulfate in proportion to body weight, approximately 0.05 mg/kg.

(3) **Support therapy.** 2-PAM (Pralidoxime Chloride or Protopam Chloride).

(a) Adult dose – 1 gm IV slowly.

(b) Infant dose – 250 mg IV slowly.

Note. Contraindicated treatment compounds include: aminophylline, barbituates, morphine, phenothiazine tranquilizers, theophylline, or any respiratory depressant.

8-30. Carbamate Pesticide Poisoning and Suggestions For Treatment

a. Commonly used pesticides that exhibit reversible cholinesterase inhibition include carbaryl, dimetilan, and propoxur.

b. Signs and symptoms of poisoning include pupillary constriction, salivation, profuse sweating, lassitude, loss of muscle coordination, nausea, vomiting, diarrhea, epigastric pain, and tightness in chest.

c. **Antidote**

(1) **Adults.** After cyanosis is overcome, give 2 to 4 mg of atropine sulfate IV. Repeat doses at 5 to 10 minute intervals until signs of atropinization appear. Maintain treatment for 24 hours or longer if necessary.

(2) **Children.** Give atropine sulfate in proportion to body weight, approximately 0.05 mg/kg IV.

Note. 2-PAM is contraindicated in carbamate insecticide poisoning. Also avoid aminophylline, barbiturates morphine, phenothiazine, tranquilizers, and theophylline.

8-31. Organochlorine Pesticide Poisoning and Suggestions For Treatment

a. Organochlorine pesticides are central nervous system depressant/stimulants. They include benzene hexachloride (BHC), chlordane, DDT, dieldrin, heptachlor, and lindane. The exact mode of actions of these chemicals is not known. In general they act on the central nervous system to stimulate or depress, varying by compound. Repeated doses may affect liver and kidney functions.

b. **Signs and symptoms.** Within 20 minutes to 4 hours, the following may occur: headache, nausea, vomiting, restlessness, tremor, apprehension, convulsions, coma, respiratory failure, and death. Do not induce vomiting if the ingested poison is principally an organic solvent (e.g., kerosene).

c. **Treatment**

(1) Lavage stomach with 2-4 liters of tap water. Induce catharsis with 30 gm sodium sulphate in 1 cup of water.

(2) Administer barbituates in appropriate doses repeated as necessary for restlessness or convulsions.

(3) Avoid oils, oil laxatives, and epinephrine (adrenalin). Do not give stimulants.

(4) Give calcium gluconate (10% in 10 ml ampules) IV every 4 hours.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION VI. VECTOR CONTROL: SHIPBOARD AND ASHORE

8-32. Shore Installations

Pest management programs at shore installations are covered in DOD Directive 4150.7 series, OPNAVINST 6250.4 series, and NAVFACINST 6250.3 series. The Armed Forces Pest Management Board publication, Technical Guide No. 24, Contingency Pest Management, contains valuable information on the procurement and use of pesticides and pest control equipment. The above listed publication and references should be used in conjunction with control recommendations contained in this chapter.

8-33. Advanced Bases and Disaster Areas

Vector control components and disaster vector control survey teams serve as "Special Operating Units" and carry out the responsibilities described in article 8-3 under the direction of the supervising medical department.

8-34. Flies

a. **Relation to man.** The importance of many fly species to man is their capability of transmitting human and zoonotic diseases which may seriously hamper military operations. In addition to the health aspect, virtually all fly species can be annoying pests of man. One of the most important of these pests is the house fly. While being a serious annoyance, it is capable of transmitting disease-producing organisms via its vomitus and excrement, and on its contaminated feet, body hairs, and mouthparts. Chief among these organisms are those that cause cholera, dysentery, and typhoid fever. Blowflies carry many of the same organisms. Their larvae sometimes develop in wounds or natural body openings causing a condition known as myiasis. The stable fly, unlike the above two insects, is a bloodsucking fly and is suspected of transmitting anthrax and tularemia. Sand flies transmit tropical and subtropical diseases. Punkies or biting midges, are minute bloodsucking flies that cause extreme annoyance to man in many parts of the world. Tsetse flies are bloodsucking and have considerable importance because they transmit the protozoan trypanosomes that cause human African sleeping sickness. Blackflies are small bloodsucking insects which are important as pests in areas of running streams, but even more so, as the vectors of filarial parasites in Mexico, Central America, South America, and Africa.

Horse and deer flies are bloodsucking insect pests that attack both man and animals and transmit tularemia. Eye gnats are non-biting flies that are attracted to wounds, pus, and secretions around the eyes and nose. In some parts of the United States they mechanically transmit the organism, which causes acute infectious conjunctivitis (pink eye).

b. **Biological Characteristics.** All flies resemble each other in having two wings and four major developmental stages (egg, larva, pupa, and adult). A summarized description of the biology of each of the principle types follows:

(1) **House Fly (Musca domestica).** This fly is ubiquitous and consequently is possibly the most widely distributed insect pest of importance to mankind. Its eggs are deposited in decaying vegetable and animal matter such as garbage, contents of pit latrines, animal manure, spilled animal food, and soil contaminated with organic matter. The female may lay as many as 20 batches of eggs at 3 to 4 day intervals. Under favorable conditions the eggs hatch in 8 to 12 hours. The larvae (maggots), which are creamy white and grow to about 13 mm (0.5 in) in length, move about in the breeding medium to secure optimum temperature and moisture conditions. This developmental stage varies from 3 to 24 days but usually, in warm weather, it is 4 to 7 days. When growth in this stage is completed, the larvae crawl to the edge of the breeding medium, burrow into the soil or debris, and become encased in a brown pupal case. The pupal stage usually lasts 4 to 5 days but, under very warm conditions, only 3 days may be required. In cold weather this stage may last for several weeks. When metamorphosis (from the larval to adult stage) is complete, the adult fly breaks open the end of the puparium and crawls out. It works its way to the surface, expands its wings, and flies away. Mating occurs 1 to 2 days after pupal emergence. The adult is gray in color with a gray thorax marked by four equally broad, dark longitudinal stripes. The mouthparts are non-biting and adapted to sponging. House-flies use a wide variety of material for food including organic filth, human foodstuffs, and agricultural waste. Because they can take only liquefied foods, they moisten substances with a "vomit drop" from their crop. This drop of fluid, often teeming with microorganisms, dissolves solid materials to be used as food. This fluid food is sponged up. This feeding method, combined with the habit of walking over organic filth, accounts for the ease that they transmit disease organisms to food, and cooking and eating utensils. The "fly speck" vomitus (light colored) and fecal discharge (dark colored) both serve as sources of contamination. When inactive, flies tend to congregate in certain preferred resting places. The proper use of residual sprays for house fly control requires that these resting places be determined. Indoors, flies tend to rest on over-head structures, particularly on cords and the edges of objects. Where temperatures remain high during the night, houseflies frequently congregate outdoors on fences, weeds, and in low branches of trees. Although houseflies usually stay within a short distance of the breeding sites, they may become dispersed for distances of several miles. In tropical and subtropical areas, houseflies continue breeding at varying rates throughout the winter. In temperate areas, depending on the weather, these flies survive the winter by pupal hibernation and semi-continuous breeding in protected situations.

(2) **Blowfly (Calliphora, Chrysomya, Lucilia Phoenicia, Phormia, etc.).** Blowflies, also known as bluebottle and greenbottle flies, are identifiable by their large metallic shining blue, green, or black abdomens. They usually deposit their eggs upon carrion; however, they will ovi-posit upon a wide range of fresh decaying refuse if carrion is not available. Eggs occasionally may be deposited in or near body openings of living animals, but clean healthy animals are rarely attacked. Upon emergence from the egg, the larvae feed for a short time on or near the surface.

As the necrotic tissue food source is depleted, they move into areas of less putrid material. When fully developed, the larvae leave the breeding medium and burrow into loose soil or sand to pupate. The life cycle varies from about 9 to 25 days. Blowflies are keenly perceptive to odors given off by carrion and, consequently, will fly long distances in response to this stimulus. Although blowflies may serve as mechanical vectors of disease organisms in the same way as houseflies, they do not present the same public health problem since they rarely enter dwellings. The larvae of these flies sometimes referred to as surgical maggots, have been implicated in myiasis.

(3) **Flesh Fly (Sarcophaga and Wohlfahrtia).** The flesh flies are medium gray in appearance and are often relatively large in size. They are distinguished from other domestic flies by the presence of three longitudinal black stripes on the thorax and a checkered effect on the usually red-tipped abdomen. These flies are commonly referred to as flesh flies since the larvae of some of them infect living flesh. Many species are known to breed prolifically in animal feces, especially that of dog. They differ from other domestic flies in that the females deposit larvae rather than eggs. The flesh flies are often very abundant, but they do not ordinarily enter habitations. They do not appear to be of importance to man from the standpoint of mechanical disease transmission, nor are they considered an important pest. However, they are important as an indication of unsanitary conditions and have been associated with cutaneous, genitourinary, intestinal, and nasopharyngeal-opthalmomyiasis.

(4) **Bot and Warble Flies (Cuterebra, Dermatobia Gasterophilus, Hypoderma spp., and Oestrus spp.).** These flies cause obligate myiasis. Normally the larvae of bot flies (Gasterophilus spp.) inhabit the gastrointestinal canal of animals of the family Equidae. Larval development requires 10 to 11 months. In the rare cases of human infection, first stage larvae are found under the skin, giving rise to a creeping cutaneous myiasis. Treatment is by surgical extraction. Among the warble flies, the larvae of Dermatobia hominis, whose eggs are carried by female mosquitoes, is found in the human skin in Central and tropical South America. The life cycle requites 3 to 4 months. Larvae of Oestrus spp. are found in the nasal cavities and cranial sinuses of sheep, goats, and related wild animals. In areas where numerous infested animals occur, man may become infested. In these cases, the larvae may be found in the buccal mucosa and conjunctive, but more frequently in the nasal cavities. Severe frontal headaches result. The larvae of Hypoderma spp. can be found under the skin of cattle, goats, deer, and large game animals. They can give rise to creeping eruption in man. Numerous human infections occur and the incidence is proportionally higher in children than adults. With man being an unnatural host, the larvae may migrate throughout the body (e.g., eyes dermal and subdermal tissue, the jaw, and possibly the spinal canal). Associated pain is severe, and while death may result, surgical removal is possible. Cuterbra spp. larvae commonly cause myiasis in rodents of many genera and rabbits. In these animals, severe infestations may lead to encapsulating dermal tumors. Occasionally dogs, cats, and man may become infected. Although rare, in human cases, the larva forms a boil-like lesion in the dermal and subdermal tissue, but the larvae are easily removed.

(5) **Stable Fly (Stomoxys calcitrans).** The stable or dog fly is bloodsucking and closely resembles the house fly in appearance. It is distinguished from other domestic flies by its piercing proboscis that protrudes bayonet like in front of the head. It normally breeds in wet straw, mixed straw, and manure or piled fermenting vegetation, such as grass, seaweed, and similar materials. Development requires 21 to 25 days. The stable fly is not attracted to and does not breed in human food, feces, garbage, and other filth that are attractive to the house fly. Consequently, it is not considered to be an important mechanical transmitter of human disease organisms. However, its painful biting habits make it a serious pest for morale. There is some evidence to implicate this fly with the transmission of anthrax and tularemia. Rarely, it becomes involved in accidental traumatic and enteric human myiasis.

(6) **Horn Fly (Haematobia irritans).** The horn fly is a cattle pest related to S. calcitrans. The female prefers to oviposit in fresh cow feces. Upon hatching, the larvae crawl into the fecal mass, develop for 3 to 5 days, pupate under the pat and emerge as adults in about 7 days. The life cycle is completed in 10 to 14 days. The horn fly rarely bites man, but in large numbers it does cause annoyance.

(7) **Tsetse Fly (Glossina spp.).** Tsetse flies are easily recognizable by the way in which they fold their wings scissor-like above the abdomen when resting, the characteristic discal cell (cleaver shaped) in the wing, and the prominent biting mouthparts. These flies are restricted to the African continent south of the Sahara Desert. The female periodically produces a single, fully developed larva, which pupates almost immediately in loose soil, moss, or other accumulations of material. Usually, tsetse flies require bush, thickets, or forest to rest and breed. Open areas, savanna, or openings in the forest are preferred for feeding. Both sexes of these flies are bloodsuckers that feed on man and animals and transmit the protozoan disease, African trypanosomiasis (African sleeping sickness).

(8) **Sand Flies (Phlebotomus spp. and Lutzomyia spp.).** The flies of these genera are small and moth-like, rarely exceeding 5 mm (1/25 in) in length. Their bodies and wings are densely covered with hairs. The wings are either oval or lanceolate shaped and, when at rest, are held upward and outward to form a 60-degree angle with each other and the body. Only the females have piercing mouthparts for sucking blood. The males suck moisture from any available source. They have a wide distribution, occurring in such diverse places as deserts and jungles, but are absent from the colder regions of the Temperate Zones. They invade open dwellings to bite man during the evening and night, hiding in dark protected places during the day. Indoors, they may be found in dark corners and near the ceilings of sleeping quarters. While outdoors, they hide in masonry cracks, stonewalls, excavations, animal burrows, hollow trees, and deep cracks in the soil. The eggs are laid where there is an abundance of organic matter and sufficient moisture for their development. They are weak flyers. Their mode of flight is characteristic in that for longer distances they have slow steady movement. For shorter distances they move in so-called "hops." Normally, their dispersal is limited to the immediate region of their breeding areas. The diseases these flies transmit to man are bacterial (Bartonella), viral (sand fly or pappataci ever), and protozoa! (Leishmania spp., kalaazar, oriental sore, and American mucocutaneous leishmaniasis).

(9) **Blackfly (Simulium spp.).** Blackflies are small, 1 to 5 mm (1/25 to 1/5 in) in length, dark, stout-bodied, humpbacked flies with short broad wings in which only the anterior veins are well developed. The antennae are short and stubby. The immature stages of blackflies develop in running water. Usually, masses of eggs are deposited singly directly on to aquatic plants, submerged logs, and water splashed rocks. However, some species drop their eggs while flying over the water surface and the eggs sink to the bottom. Following incubation, the eggs hatch and the larvae become attached by a caudal sucker to submerged objects. They are kept from being washed away by a salivary gland secreted silken thread. Larvae feed on microorganisms that are strained from the water after being swept into the mouth by a pair of fan-shaped filamentous structures on the head. They breathe by obtaining oxygen from the water through three small gills located dorsally on the last abdominal segment. The larvae pupate within the cocoon that it spins, firmly attached to a submerged object. Depending on the species and environmental factors such as temperature and availability of food, the total period of the aquatic life stages may vary from 2 to 14 weeks. Metamorphosis to the adult takes place within the cocoon. Upon emerging and rising to the surface, the fly takes wing immediately. Little precise information is available on the dispersal range of blackflies, but it is believed to be more than a mile, particularly in open terrain. Like mosquitoes, both sexes of blackflies feed on plant juices. The females also feed on the blood of wild and domestic animals and birds, while several

species regularly feed on man. Only the females bite. Due to the large size of the bite wound and the presence of fly secreted anticoagulant, the bites bleed freely and may become secondarily infected. Several species cause serious annoyance to man because of the habit of flying closely about the face and crawling or probing all exposed skin surfaces. The females vector the filarial parasites that cause onchocerciasis in man and animals, and the avian protozoan blood parasite, Leucocytozoon.

(10) **Biting Midges (Culicoides, Leptoconops, etc.).** These bloodsucking flies, often called no-see-ums, punkies, or salt-marsh sand flies, are extremely small [1 to 5 mm (1/25 to 1/5 in) in length] and have long slender antennae and narrow wings that are carried flat over the body. Although information on their breeding habits is not complete, some species are known to breed in fresh water inlets, tidewater pools, water-holding tree holes, wet decaying humus along densely shaded areas of streams, and in marshes and swamps. Adults may be found as far as 5 km (3 miles) from their breeding sites. The female inflicts a painful bite, attacking humans mainly in the evening and early morning hours.

(11) **Horse and Deer Flies (Tabanus, Chrysops, etc.).** Horse and deer flies are robust insects, with powerful wings and large rounded heads. They range in size from about that of a house fly to nearly 25 mm (1 in) in length. They prefer warm, sunny locations, and are especially active on humid days. Eggs are glued in layers or masses to rocks or vegetation overhanging water or damp soil. The egg stage usually lasts less than 2 weeks. Upon hatching, the larvae drop into the water or to the ground. Depending upon the species, the larvae require 1 to several years to complete development. Mature larvae migrate to dryer soil for pupation where after 1 to 2 weeks the adult flies emerge. These flies inflict exceedingly painful bites and, when numerous, seriously interfere with outdoor operations or recreation. They are also known to vector bacterial (anthrax and tularemia), protozoan (trypanosomes), and helminthic (Loa loa) infections to man and/or animals.

(12) **Eye Gnat (Hippelates).** Members of the genus Hippelates are very small flies [1.5 to 2.5 mm (1/16 to 1/10 in) in length] which have been given the name “eye gnats” or “eye flies” because of their predilection for eye secretions. They are also attracted to wounds, pus, and sebaceous secretions. They are extremely annoying to man because of their persistent habit of swarming closely about the face. Although these flies are incapable of piercing the skin to take blood, their mouthparts are equipped with upturned spines that act as fine cutting instruments. With these structures, they are able to abrade the edges of sores and the conjunctival epithelium. The life cycles for many Hippelates spp. are not completely known. However, generalizations may be drawn from what is known about Hippelates colusor. Breeding continues year round but at a lower rate in winter. The eggs are deposited at weekly intervals in batches of 50 or less on or below the surface of loose, well-aerated non-putrid soil, which may contain fecal material and/or plant material. The average incubation time under optimum conditions (32 degrees C/90 degrees F) is about 2 days. The larvae feed on decaying organic material, including feces, and complete development in about 7 to 11 days. Pupation takes place close to the surface in the larval feeding medium and lasts 6 to 7 days.

c. **Control of Domestic Flies.** Successful control of domestic flies, when necessary, depends upon improved environmental sanitation in conjunction with selected application of insecticides. Prevention of fly breeding and entry into buildings reduces the potential for disease transmission and, simultaneously, increases the impact of any chemical used in reducing fly numbers.

(1) **Sanitation.** Effective sanitation measures and proper policing of grounds are of primary importance in fly control. This is particularly relevant in view of the increasing amount of insecticide resistance problems. With proper sanitation, less dependence needs to be placed on insecticides. Any fermenting or decaying organic matter, including human and animal feces, dead animals, fish and meat refuse, and discarded foodstuffs are potential breeding places for flies. Therefore, the elimination of all sources of attraction for flies is essential. Proper disposal of food service wastes, including all garbage and such liquids as wash water, reduces the attraction of flies to the dining facility area. Garbage should be deposited in well-covered containers which, when empty, should be washed regularly. These containers should be kept outside of dining facilities and preferably off the ground on a stand or rack. Effective disposal methods must be used for garbage, non-salvable compressible waste, and rubbish. Refer to NAVMED P-5010, Chapter 9, Manual of Naval Preventive Medicine for Ground Forces which discusses field waste disposal methods.

(2) **Chemical Control**

(a) **Control of Immature Stages**

<u>(1)</u> **General.** Larviciding usually is not practical in a large operation because breeding places are too scattered for effective treatment. However, this method is indicated for control in areas of concentrated breeding, such as garbage-handling zones, livestock and poultry farms, and piles of compost materials and carcasses. In all larvicidal treatments, emphasis must be placed upon getting the insecticide to the site where it can act upon the larvae. Extensive reliance on larviciding should be avoided since it probably precipitates the development of resistance. Latrine structures should be treated with residual insecticides. Human excrement in latrines normally does not produce many M. domestica because they do not propagate well in the semi-liquid media. On the other hand, the pestiferous and myiasis producing soldier fly, Hermetia illucens, breeds prolifically in the semi-liquid material in untreated latrines. When insecticides are used to destroy H. illucens larval populations, the media becomes semisolid in nature and thus, suitable for house fly breeding.

<u>(2)</u> **Insecticides.** Larvicides should be applied until the breeding medium is saturated to a depth of 50 to 75 mm (2 to 3 in). This usually requires large amounts of dilute spray. Since most larvicides also act as adulticides, spray applications should be directed to locations where the emerging adults will contact the chemical as they attempt to leave the breeding material. In most cases, adding sugar to the spray enhances the insecticidal activity of these insecticides by functioning as a fly attractant. Where the pit latrine contents are relatively dry, fly breeding can be controlled by sprinkling PDB over the pit surface at the rate of approximately 60 gm (2 oz) per latrine per week. This treatment is effective only when pits are deep, dry, and unventilated. Application of PDB at a rate of 60 gm per garbage container for home use gives control for 1 to 2 weeks.

(b) **Control of Adults**

<u>(1)</u> **Residual Application**

<u>(a)</u> **General.** Should sanitation measures for fly control be found inadequate, application of residual insecticides to areas of fly congregation may be necessary to provide a satisfactory level of control. The surface areas to be treated include resting places in buildings, such as overhead structures, hanging cords, moldings, door and windows facings, tent lines, and tent exteriors. Resting places, such as building exteriors near breeding sites, open sheds;

garbage cans, shrubs, and low trees may also be treated with residual insecticides. For best results the places to be treated should be determined in advance, and application should be made only to the actual resting sites. These sites can best be determined with a flashlight at night and by looking for the presence of "fly specks." Spray equipment with a fan-type nozzle is recommended for residual applications, and surfaces should be thoroughly wetted. Paintbrushes and rollers can be used.

(b) **Insecticides.** Several insecticides can be applied as selective spot treatments, and will provide good temporary indoor control. Outdoors, if necessary, insecticides may be effectively sprayed on exterior surfaces around garbage cans, garbage racks, and screens. When spraying, cover infested areas thoroughly, avoid contamination of food or utensils, and do not use sugar mixtures. Do not permit personnel or utensils to contact wet treated surfaces.

(1) **Aerosol space spraying and area treatment.** Where residual and larvicidal applications and environmental sanitation fail to give satisfactory fly control, space sprays, dispersed as aerosols, can be used effectively for the prompt elimination of flies inside buildings. They have no lasting effect; frequent re-treatment is necessary. Aerosols may be used for area treatment outdoors when flies are active.

(2) **Poison baits.** In certain situations poisoned baits may be used effectively in the control of adult flies. Basic formulations of both liquid and dry baits consist of a strong toxicant and a fly attractant. Widespread use of baits in an area is not desirable. Bait applications should be used where large concentrations of flies are observed. The frequency of the application depends largely upon the existing fly breeding potential. Where the potential is high, repeated applications, even daily, are necessary. Usually the need for routine treatment stops after several weeks. Consequently, the frequency and amount of bait used can be reduced.

(3) **Miscellaneous Control Methods**

(a) **Screens.** Screens are a necessary aid in preventing flies from coming in contact with personnel, food, and drink. The use of adulticides is much more effective where adequate screening exists. Screens should have an 18 x 18 mesh, should be designed to open outwards, and should be in direct sunlight whenever possible.

(b) **Fans.** High velocity electric fans, properly placed over doors or in positions that blow a direct air current against the doorway, tend to prevent flies from entering when the doors are opened. If the fans are properly placed they can be useful as a supplementary method of fly control in places where doors must be opened repeatedly (e.g., food service facilities).

(c) **Fly Paper.** This material may provide a useful index of fly populations during survey or investigational work, but it is relatively ineffective as a control method.

(d) **Baited Traps.** Many types of baited traps have been developed for fly control. They can provide adequate control providing enough traps are used. They do not provide adequate control where heavy fly populations exist.

d. **Control of Stable Flies, (Stomoxys spp.)**

(1) **Sanitation.** The first and most important step in the control of S. calcitrans is destruction or removal of their oviposition sites. Since stable flies breed in all types of damp decaying vegetable matter, this process involves finding the breeding places and then either destroying these sites or making them inaccessible to the flies. Where breeding is occurring in agricultural waste (e.g., straw, manure, and other organic refuse), standard recommended practices should be used for proper storage or disposal of these wastes. For example, they should either be kept dry or spread so thinly that they will not support fly breeding. Stable flies commonly breed in decomposing seaweed that is washed into windows on ocean beaches above normal tide levels.

Disposal of this material generally is not practical thus, necessitating selective larvicide use. The extent and frequency of larviciding can be reduced by careful surveys because it is known that any accumulation of seaweed that is submerged for 6 hours or more during the 2-week period required for development of the immature stages will not require chemical treatments. Such submersion is natural sanitation and kills most of the larvae and pupae.

(2) **Chemical Control**

(a) **Control of Immature Stages.** Breeding may be controlled by thoroughly wetting the breeding material with an approved larvicidal spray where no direct threat to aquatic wildlife exists.

(b) **Control of Adults.** A number of insecticides are effective against more than one genus of fly, but the method of application would be different for each. For example, adult stable flies may be killed with the same materials and in the same manner as recommended for houseflies. However, poison baits are not effective for stable flies. Where these flies cause human discomfort and control measures are not feasible, such as protection of troops in the field, personal application of diethyltoluamide (DEET), a standard insect repellent, is recommended (see article 8-47).

e. **Control of Tsetse Flies (Glossina spp.).** Because of the diversity of habits among tsetse flies and the practical absence of a free-living larval form, they are difficult to control. Among the many types of control that have been or are being used are: traps, natural enemies (biological control), cover modification, control of host game animals, establishment of fly barriers consisting of clearings or thickets that would inhibit fly movement and/or reproduction according to the species involved, and quarantine areas. Aerosol space sprays have also been used effectively for adult control. Entire river courses have been treated, causing a reduction of up to 99 percent in adult Glossina palpalis. Glossina morsitans normally does not breed along rivers and is more difficult to control because of large areas of forest that must be sprayed. Quarantine areas have been set up in various parts of Africa that consist of barriers along roads.

f. **Control of Sand Flies (Phlebotomus spp. and Lutzomyia spp.).** Sand flies have a very short flight range so elimination of potential breeding sites near an infested area will give relatively good control within a limited area. Elimination of these sites may include complete drainage and drying to remove moisture necessary for development. Stone and rocky areas may be covered with dirt; rock walls, and stone masonry may be either destroyed or faced-over with mortar to eliminate cracks and crevices. The flight habits of phlebotomine flies render the species vulnerable to the application of residual sprays. The adult flies frequently rest on outer walls before entering a building. They enter by a series of short, hopping flights with relatively long pauses. Once inside, they may linger for a time on the walls before seeking a blood meal source. Application of residual sprays with the equipment and dosages recommended for houseflies and mosquitoes is suitable for the control of sand flies. Sleeping quarters and rooms occupied after dark should be treated as well as doors, windows, and screens. An even greater margin of protection is obtained by spraying the outside of doors, windows, and +0.5 m of the wall surrounding these openings. The application of residual spray solutions to the interior surface of tents and around the openings, including the flaps, bottom edges, and ventilation openings is also recommended. Emulsion formulations should ***not*** be used on tents because they will break down the waterproofing and cause tents to leak during subsequent rains. In some situations, extending the spraying program to include outdoor applications of residual insecticides may expand local area control. This will deny the sand flies the customary outdoor shelters and/or breeding places, and present lethal barriers between the adult flies and the buildings to be protected.

g. **Control of Biting Midges.** For these flies, it must be determined whether the problem is serious enough to warrant control efforts because they are seldom completely successful. The most effective control is obtained while they are in the immature stages because at that time they normally are clustered. However, for biting midges, it is difficult to determine where breeding is occurring because of their habit of developing in the soil. In addition, the larvae are very small. Very careful survey work with soil flotation methods is necessary to demonstrate the presence of the larvae. This procedure is tedious and, even in the hands of experts, subject to a considerable number of false negatives. Any serious attempt to effect control of human biting midges must be preceded by an extensive and careful larval survey. Where the area supporting larval breeding can be determined, control of larvae can be obtained by the direct application of insecticides to the soil. This is an expensive procedure because control must be done on an area basis at periodic intervals to eventually eliminate entry by adults from surrounding uncontrolled areas. Such treatments must be thorough and, consequently, are also injurious to many forms of aquatic life. These treatments may also lead to a rapid buildup of insecticide resistant flies. Aerosol space spray treatments against the adults, which will be described below for blackflies and mosquitoes, is possibly the most effective control measure presently available for bringing relief to small groups of people. The camp and personnel protective measures recommended for mosquitoes (article 8-35 and 8-47 respectively) are all equally effective against biting midges. Their extremely small size must be kept in mind wherever mesh or fabric screening is to be used. In order to exclude biting midges, 20-mesh screening is required; however, this will seriously interfere with ventilation. Because of this problem, insecticide treatment of screens can provide considerable control and relief against flies lighting on or passing through them. A deficiency in this control method is that the insecticide on the screen is eventually covered with windblown dirt and dust particles.

h. **Control of Blackflies (Simulium spp.).** Blackflies are effectively controlled by the application of larvicides to the streams where the immature forms are developing. Where only one brood of blackflies emerges annually, a single treatment of streams should markedly reduce the fly population. If multiple generations are produced, the number of treatment should correspondingly be increased. Stream treatment should only be initiated when necessary to protect public health. Because of the long flight range of blackflies and heavy population pressures adjacent to the control area, aerosols or mist sprayers cannot be depended upon to provide adequate control. Although the biting rate of blackflies is usually much lower than that of mosquitoes, personal protective measures against them are considered to be essential. Generally, the measures described for protection against in-quarters mosquito bites (see article 8-35) apply equally to blackflies. Characteristically, blackflies crawl beneath clothing whenever the opportunity present. Therefore, tight-fitting cuffs and collars are important in preventing their bites. Protective netting and fabric must be a minimum 20 mesh per inch and 28 mesh for standard wire or fiber.

i. **Control of Horse and Deer Flies (Tabanus spp. and Chrysops spp.).** Control of these pests is difficult and frequently ineffective. Space applications of insecticides similar to those recommended for mosquito control may be effective under some conditions, particularly if applications are made when the adult flies are active. In areas of heavy populations of Tabanus and Chrysops, the use of adulticides has not proved to be overly satisfactory. The use of larvicides has the same drawbacks as described for the larval control of biting midges. The personal protective measures described for mosquitoes (see article 8-35) are fairly satisfactory for protection against these flies, except that current standard repellents are not always successful. Horse and deer flies will occasionally enter quarters, but not for biting; consequently, protection while in quarters is not a problem.

j. **Control of Eye Gnats (Hippelates spp.).** The eye gnat species, Hippelates pusio and H. collusor, are the most troublesome to man within the United States. Efforts to effectively control these species by the use of aerial and ground delivered sprays and aerosols have generally been unsuccessful. Because these flies commonly breed in fresh turned soil, successful control can sometimes be accomplished by modifying agricultural methods. This would include conversion of cropland to pasture and shallow disking when cultivation is necessary. Soil application of insecticides may have some promise. However, the success of the methods of agricultural and insecticide control is contingent on the biology of the flies, but all of the life cycle information is not yet known. Where eye gnat problems are encountered and in the absence of control measures known to be successful locally, the assistance of appropriate technical personnel should be obtained.

8-35. Mosquitoes

a. **Relation to Man.** Mosquitoes rank first in importance among the insects that transmit diseases to man. This is partially because their biting habits vary among genera and species with regard to habitat, time of day, and host type and availability. This variability is important because it causes exposure to and subsequent transmission of different disease organisms (e.g., periodic and non-periodic filariasis). The genera most frequently associated with disease transmission are Aedes, Anopheles, and Culex. Disease organisms vectored by mosquitoes to man include bacteria (tularemia), arboviruses (dengue, encephalomyelitis (Eastern, Western, St. Louis, West Nile, Japanese B, and Russian Spring-Summer), and Yellow Fever), protozoa (malaria), and filarial nematodes (Wuchereria bancrofti, Brugia spp., and Dirofilaria immitis). Besides serving as disease vectors, many species of mosquitoes are serious pests of man solely because of their irritating bites.

b. **Biological Characteristics.** Mosquitoes oviposit on the surface of water or on surfaces subject to flooding. Larvae hatch and feed on organic matter in the water, pupate, and emerge as adults. Mosquitoes use a great variety of water sources for breeding. These include: ground pools, water in artificial containers, water-holding tree holes, and leaf axils. Adult mosquitoes, when not actively seeking food, rest in concealed places. Only the females feed on blood. Depending upon the species involved, the distance of dispersal from breeding areas varies from a few meters to many kilometers. Males normally do not fly long distances from breeding areas; consequently, any uncommonly large concentration of males usually indicates that the breeding area is near.

c. **Surveillance of Mosquitoes.** See article 8-56 for details on collection.

d. **Control.** Mosquito control methods are classified as being either permanent or temporary depending upon whether they are designed to eliminate breeding areas or simply to kill the present population. Aside from the elimination of artificial water holding containers in campsites, permanent control measures have a high initial cost and require considerable periods of time to complete.

(1) **Control of Immature Stages.** Temporary control of mosquito breeding is accomplished by treating water surfaces with larvicides. Larviciding equipment is described in Section VIII of this chapter.

(a) **Ground Larviciding.** Where no larval resistance to insecticides has been documented, solutions, emulsifiable concentrates, granules, and water-dispersible powders may be used effectively for larviciding with ground-operated equipment. The use of granules is indicated where heavy vegetation covers must be penetrated or where possible damage to crops (e.g., rice) is a consideration. Because the percentage of toxicant and application rate vary with the type of equipment used, species of mosquito involved, geographical area considered, and with the degree of resistance developed, current recommendations should be obtained from appropriate technical personnel (see articles 8-4 and 8-5).

(b) **Aerial Larviciding.** OPNAVINST 6250.4 series defines the use of aircraft for the dispersal of insecticides that will not normally be approved unless recommended by a Navy medical entomologist or a NAVFAC applied biologist. The responsible Naval commander in overseas areas is authorized to approve aerial dispersal of insecticides by naval aircraft when he considers such dispersal to be justified and the operation is to be supervised by qualified personnel. Aerial dispersal for mosquito control will ordinarily be justified in the continental United States and other developed areas only under the following conditions:

(1) Where permanent control measures (e.g., drainage, filling) cannot be accomplished economically.

(2) Where there is no access to ground dispersal equipment.

(3) Where screening, repellents, space sprays, and residual treatments are not adequate to control vector borne diseases or to increase work efficiency.

(4) Where ground application of aerosols, mist, or other insecticidal formulations are ineffective in reducing or controlling heavy populations.

(5) Where it is economically more practical to treat a major breeding area with aircraft rather than ground control equipment.

(c) **Control in Water Containers.** Containers, such as empty cans and old tires in which mosquito larvae may breed, should be eliminated if possible. Those that cannot be eliminated should be treated with a larvicide to control and prevent breeding.

(2) **Control of Adult Mosquitoes.** Adult mosquitoes may be controlled by the application of residual and space sprays.

(a) **Indoor Control.** Space sprays are recommended for interior control of mosquitoes when immediate eradication is required. Space sprays can be effectively applied with an aerosol dispenser. Treatment with the standard aerosol dispenser should be at a rate of 10 seconds of discharge per 300 cu m (1000 cu ft) of space. Space sprays have little or no residual effect and must be reapplied whenever new mosquitoes enter the space. Where frequent re-entry is a problem, or where disease bearing mosquito species are involved, it becomes necessary to apply residual sprays to the surfaces on which mosquitoes are likely to rest. Residual sprays differ from space sprays principally in possessing a greater concentration of the toxicant material. Only insecticides with long-lasting effects are suitable for use in residual sprays. Where rough absorbent surfaces are involved, the use of a suspension made by mixing a water-dispersible powder is more effective than the use of either a solution or emulsion. When resistance to an insecticide is suspected, contact the nearest entomologist for assistance or advice. Equipment required for residual and space applications, is described in Section VIII.

(b) **Outdoor Control.** Treatment using aerosols or mists is recommended for the outdoor control of adult mosquitoes. When control of breeding sources is not possible, aerosols are considered to be a desirable method for preventing annoyance by mosquitoes in limited bivouac areas. Aerosols will often affect complete control within a limited region and will bring adequate protection for short periods. However, in any area where reproduction is continuous and dominated by migratory species, the use of aerosols alone is satisfactory only if done on a repetitive basis. When properly applied, aerosols do not leave dangerous or unsightly deposits. Where re-infestation is not a problem, such as in less populated areas, insecticide application by means of a mist blower may provide satisfactory control.

(1) **Aerosol use.** Aerosol operations should be accomplished when wind speeds are less than 6 knots and when a temperature inversion is present. Since aerosol applications are most effective against flying insects, they should be accomplished when the target species are active.

(2) **Residual sprays.** Residual sprays have a limited exterior applicability for the protection of small camps. When used, the spray is applied to all vegetation surfaces for an area of 30 meters or more around the place to be protected and to insect resting places within the bivouac area.

e. **Protective Measures**

(1) **Screening.** Living quarters in permanent or semi-permanent camps should be protected with 18-mesh screening. Where vector species are present, bed nets should be used as additional protection.

(2) **Personal Protection.** Personal application type insect repellents are discussed in article 8-47.

(3) **Camp Location.** In areas where disease-bearing mosquitoes occur, zones outside the camp perimeter should be off-limits to all military personnel, except as required. Furthermore, care must be exercised to locate camps as far as possible from native villages to avoid contact with potentially infected mosquitoes.

(4) **Chemoprophylaxis.** Routine administration of chemoprophylatic drugs is essential in malarious areas as a supplement to vector control.

8-36. Lice

a. **Relation to Man.** The infestation of lice on a human host is termed pediculosis. Human lice are responsible for the transmission of louse-borne typhus, trench fever, and louse-borne relapsing fever. Louse-borne typhus, an historical medical problem, is one of the few serious insect transmitted diseases in which man serves as the infection reservoir. Trench fever is thought to be related to typhus fever. It does not kill, but it can be a debilitating epidemic disease among louse-infected troops. Louse-borne relapsing fever is caused by a spirochete. Although found throughout the world, it is most prevalent in parts of Europe, North Africa, and Asia. In addition to serving as the vector of these serious diseases, lice cause a great deal of misery for infested people. Human lice do not normally infest other animals.

b. **Biological Characteristics.** Three species of lice infest man: the head louse, Pediculus humanus capitus; the body louse, Pediculus humanus humanus; and the crab louse, Pthirus pubis.

(1) **Human Louse.** The body louse, Pediculus humanus humanus, and the head louse Pediculus humanus capitus are quite similar, differing principally in the part of the body normally occupied. The body louse is found upon the body, spending much of its time attached to the undergarments. The head louse is found upon the head and the neck, clinging to the hairs. The egg of the body louse is attached to fibers of the underclothing, whereas, the egg of the head louse, a "nit," is cemented to the hair. The eggs of the human louse are incubated by the host's body heat and hatch in about a week. Hatching is greatly reduced or prevented by exposure to temperatures above 37.8 degrees C (100 degrees F). Thus, it is apparent that regular washing or dry cleaning of clothes provides a reliable control method. Immature lice resemble the adult in body form and become progressively larger as development takes place. Frequent blood meals from a host are required. Lice die within a few days if prevented from feeding. Head and body lice are normally acquired by personal contact, by wearing infested clothing, or by using contaminated objects such as combs and brushes.

(2) **Crab Louse.** The crab louse is primarily found upon hair in the pubic and anal regions, but on occasion may be found in the eyebrows and other areas of the body. This insect feeds intermittently for many hours at a time and is also unable to survive more than a short time away from the host. Crab lice are spread mainly by physical contact, but also may be acquired from toilet seats or objects recently used by infested individuals.

c. **Control.** Control includes delousing of individuals, treatment of infested clothing, bedding, living areas, and toilet facilities and the prevention of new infestations. Human louse control measures should be coordinated with a medical officer.

(1) **Preventive Measures.** The following preventive measures, especially during crowded shipboard and tenting or refugee operations, should be taken:

(a) Avoid physical contact with louse-infested individuals and materials.

(b) Observe personal cleanliness, i.e., at least weekly bathing with soap and water and clothing changes (particularly under-clothing).

(c) Avoid overcrowding of personnel.

(d) Instruct personnel on the detection and prevention of louse infestation.

(2) **Individual Treatment Measures**

(a) **For Head and Crab Lice,** insecticidal ointment and shampoos for individual treatment are available as prescription medication issued by the medical department. Apply the powder lightly to the hair and rub it in with the fingertips.

(b) **Body Louse.** For treatment of body lice infestations, wash all clothing and bedding in hot water and repeat in 7 to 10 days. Since extra clothing, bedding, and toilet facilities serve as sources of re-infestation; these items should also be washed.

(c) **Head Louse.** Insecticidal shampoos are quite effective and available at military pharmacies.

(d) **Crab Louse.** Insecticidal ointments and shampoos are also available and quite effective. Do not bathe for at least 24 hours. One or two repeat treatments may be necessary.

8-37. Bedbugs (Cimex Spp.), Shipboard And Ashore

Bedbugs infest warm-blooded animals including man and are occasional pests aboard ships. They are not known to vector human diseases, but they are annoying and can seriously affect morale. Bedbugs are approximately 6 mm (1/5 in) in length, flat, reddish-brown, and wingless insects with sucking mouthparts. They have nocturnal movement and only feed on blood. Their bite usually produces small, hard, white swellings (wheals). Bedbug infestations are not necessarily associated with unsanitary conditions. They are often transported to clothing, baggage, and laundry and may be easily introduced into very clean quarters. Habitual hiding places of bedbugs, such as in the seams of mattresses, will often be obvious by the presence of dried black or brown excrement stains on surfaces where they congregate and rest. Bloodstains on the bedding may also indicate their presence. For control, light applications of an appropriate insecticide, recommended by the area entomologist, should be made to the sides and seams of mattresses, which are best treated by folding and placing them in the center of the bunk at a 45-degree angle. Other sites to be sprayed should include cracks and corners of the bunks, empty lockers, springs, canvas bottoms and grommets, stanchions, and behind all equipment close to bulkheads. Bunks may be made up and occupied after 4 hours of ventilation following application. Complete control should be expected within 10 to 14 days.

8-38. Cockroaches, Shipboard And Ashore

a. **Relation to Man.** Cockroaches are probably the most common and persistently troublesome arthropod pest encountered indoors. They are among the most adaptable insects known. It has never been demonstrated that cockroaches directly vector pathogenic organisms but, significant circumstantial evidence indicates that cockroaches maintain and disseminate pathogens. Bacteria, viruses, and protozoa have been isolated from them or their feces. Because of their habits and close association with man, they are well adapted for mechanical transmission of diseases such as amebiasis or other gastrointestinal disease organisms. This discussion is designed to provide information for effective control of cockroaches whether they are located aboard ship or ashore. Considerations concerning cockroach infestations include the following:

(1) Their presence is considered an indication of substandard sanitation by most people.

(2) They often cause anxiety and repulsion and may lead to entomophobia (fear of insects), which is of special consideration in regard to hospital patients' comfort and recovery.

(3) Cockroaches habitually disgorge portions of partly digested food and defecate wherever they go. They also discharge a nauseous secretion from oral and abdominal glands which leaves a persistent and typical "cockroach odor" on all surfaces contacted.

(4) Cockroaches defile, contaminate, or damage food, linens, books, utensils, and other supplies and equipment.

b. **Responsibility for Shipboard Cockroach Control.** The shipboard medical department has been charged with responsibility for pest control operations. Harbor craft and small vessels without a medical department representative should obtain assistance from the medical department and/or pest control shop of their local activity.

c. **Cockroach Biology and Identification.** An understanding of the habits and life history of the cockroach is a prerequisite to successful control. Those that are briefly described here are the most notorious from the standpoint of frequency and size of populations and affinity for indoor habitats. This is true regardless of climate or elevation since heated buildings and ships provide a relatively constant environment acceptable to the cockroach. They are omnivorous, adapting well to a variety of food sources, and prefer to be active under subdued lighting conditions.

(1) **German Cockroach, Blatella Germanica**

(a) **Appearance.** The late egg stage is passed in a dark yellowish brown to tan colored capsule or egg case which is carried, protruding from the abdomen, by the female for about 2 weeks until, or shortly before, the eggs hatch. The female produces an average of 6 capsules, each containing up to 50 eggs. The young (nymphs) pass through 7 molts in 40 to 60 days. The life span is 6 to 10 months with 2 to 4 generations per year. The adult is tan or straw colored, about 15 mm long and distinctively marked with two longitudinal dark stripes near the head.

(b) **Habits.** This is the most common indoor species, especially in and around food service spaces and facilities. Infestation is a recurring problem in galleys, mess halls, exchange snack bars and cafeterias, coffee messes, bakeries, butcher shops, vegetable preparation rooms, and potato lockers. It frequently occurs in hospital wards in diet kitchens, food service carts, bed stands, lockers, soiled laundry hampers, and washrooms. Because of its size and wide distribution, the German cockroach is easily carried into fleet and shore facilities with provisions; especially fresh produce, bakery goods, soft drink cases, food and drink vending machines, and even laundry. This cockroach frequents secluded cracks and crevices in the walls, wood and metal trim, fixtures, electrical appliances, furnishings, and other similar places.

(2) **Brown-banded Cockroach, Supella Longipalpa**

(a) **Appearance.** The dark reddish-brown egg capsules, containing an average of 15 eggs, are securely glued by the female in cracks, corners, and angular locations in furnishings, fixtures, clothing, and draperies where hatching takes place. Each female produces an average of 10 egg capsules. The young pass through 6 to 8 molts in about 3 months. This species is lighter in color and slightly smaller than the German cockroach, being somewhat less than 15 mm long. Two light yellow cross bands near the base of the adult's wings and two transverse light bands on the dorsal surface of the nymphs give this species its name. The female is quite broad with short wings while the male is more slender with the wings extending beyond the tip of the abdomen.

(b) **Habits.** The brown-banded cockroach prefers living rooms, dining rooms, bedrooms, and closets of dwellings. It is a common pest in hotels and motels and is often found on hospital wards. It is more secretive and less obtrusive in habits than other cockroach species, hiding in cracks of woodwork, furniture, drawers, lockers, wardrobes, closets, beds, and draperies. It may infest all parts of the premises. It is not considered a "food service area" species, as is the German cockroach.

(3) **American Cockroach, Periplaneta Americana**

(a) **Appearance.** The dark reddish-black egg capsules, containing an average of 15 eggs, is firmly cemented to various substrates and often covered with debris. Each female produces an average of 34 capsules. The young emerge in approximately 35 days and molt 9 to 13 times over a period of 10 to 16 months before finally becoming mature. Hence the life cycle takes an average of 14 months and the total life span may take as long as 2.5 years. The adult is dark reddish-brown, approximately 35 mm long and the anterior dorsal plate behind the head has a conspicuous yellow posterior border strip.

(b) **Habits.** This cockroach has particularly filthy habits, frequently moving from shelters or breeding areas to food sources. It favors, and becomes abundant, in such places as damp basements, restaurants, bakeries, packing and slaughterhouses, food stores, crawl spaces under dwellings and other buildings, and sewage disposal plants. It often occurs in very large numbers in dumps; sewage manholes and conduits; and in steam tunnels and other sub-floor conduits in galleys. Therefore, its requirements for subsistence are met where there is a combination of food, warmth, dark seclusion, and high humidity. As previously noted, it commonly leaves these environs in search of food that makes the American cockroach a potentially dangerous disease vector. Its presence is often first recognized by finding its hard, dark, 3.2 mm (1/8 in) long fecal pellets.

(4) **Australian Cockroach, Periplaneta Australasiae.** This species is quite similar in appearance to the American cockroach except the adults have a yellow strip along one third of the outside margin of the fore wings and is approximately 32 mm in length. The habits of this cockroach are similar to those of other cockroaches; however, it is not commonly found indoors and has a more limited distribution. This cockroach can be particularly objectionable because of its unsightly, liquid, fecal droppings.

(5) **Other Cockroaches.** Several other species of cockroaches occasionally infest premises and include the following: Oriental cockroach, Blatta orientalis; Florida woods cockroach, Eurycotis floridana; brown cockroach, Periplaneta brunnea; Smokey-brown cockroach, Periplaneta fuliginosa; and Surinam cockroach, Pycuoscelus surinamensis. The more common cockroaches are identifiable by the general descriptions in this chapter. Descriptive characters of other important, but less frequently contacted species, can be found in readily available medical entomology manuals. In all instances, the target species should be identified before proceeding with control measures.

d. **General Control.** If the overall absence or near absence of cockroaches is to be achieved, it is essential that both sanitary and chemical control measures be established on a preventive rather than on a "trouble call" basis. Preventive control requires frequent inspections and thorough surveys. Prevention also includes good sanitation, prevention of entry, elimination of harborages, and supplemental chemical control when indicated.

(1) **Sanitation.** Active food preparation areas cannot be kept clean enough to eliminate existing cockroach populations by starvation. However, the following sanitation practices are of proven value:

(a) All food materials should be stored so as to be inaccessible to cockroaches.

(b) Garbage and other refuse should be placed in containers with tight-fitting lids and removed daily.

(c) All food preparation areas, utensils, and equipment should be thoroughly cleaned after each day's use.

(d) Foods should be restricted in berthing areas.

(e) Cleanliness reduces available food for cockroaches and may determine the degree to which the population expands. As the level of sanitation increases the level of cockroach infestation decreases.

(f) Reduction in food sources and general cleanliness may cause the population to forage further, thus, increasing the probability for cockroaches to encounter residual insecticides.

(2) **Prevention of Entry.** Although primarily important for ship's stores, items such as bagged potatoes and onions, bottle cases, and food packages must be inspected prior to storage or use to avoid re-infestation by cockroaches. Since cockroaches may be transported in egg, nymph, or adult stages, care in inspection is necessary.

(3) **Harborage Elimination.** Cockroaches do not normally inhabit structures that lack suitable hiding places. As harborages are eliminated, populations are reduced and the use of chemicals becomes less needed. The sealing of cracks and crevices and general elimination of harborages is extremely important in cockroach control. Typical harborages include the following:

(a) Old and torn insulation.

(b) Holes for plumbing and electrical lines, as well as electrical switches and fuse boxes.

(c) Areas between walls (false bulkheads).

(d) Areas behind drawers, oven hoods, under counters, and serving lines.

(e) Hollow-legs (e.g., stove legs and refrigeration and heavy equipment supports).

(4) **Surveys.** The importance of conducting cockroach surveys during routine sanitary inspections cannot be over-emphasized. Early detection of new or resurgent populations is essential for effective control efforts. The following points pertain to cockroach surveys:

(a) Surveys should be performed by a PMT or other qualified personnel. The results from each inspection should be reported in writing to the commanding officer. Aboard ship, the medical department representative (MDR) should conduct a cockroach survey every 2 weeks and appropriately log the results.

(b) Since cockroaches avoid light, they are often overlooked in routine daytime sanitation surveys. Some considerations that are helpful in detecting resting sites and harborages are:

(1) Pyrethrum, d-Phenothrin, and other pyrethroid aerosols will drive cockroaches from their hiding places within a few minutes. The spray should be directed into all cracks and crevices, breaks in insulation and pipe lagging, overhead wiring, deck drains, motor compartments of machinery, and metal supports under counters and tables. Treatment should also include areas behind splashboards and shields, false bulkheads, pictures, and bulletin boards. In many cases hard-to-eliminate infestations are due to cockroaches from an undetected breeding source, such as within walls or double floors. Do not overspray such areas because this may cause the cockroaches to migrate to new areas.

(2) A flashlight is necessary for surveying dark or dimly lit areas. Look for excrete around cracks and likely hiding places.

(3) While inspecting, keep in mind the cockroach's requirement of food, warmth, harborage, and moisture.

(4) It is necessary to stoop and crawl to conduct a good cockroach survey.

(5) Inadequate control programs aboard ship and elsewhere are invariably due in part to either a lack of or improperly conducted surveys.

(5) **Chemical Control.** Complete reliance on chemical control would be undesirable due to potential human insecticide exposure. This method is meant to supplement sanitary control measures. Some aspects of chemical control include:

(a) **Residual Contact Application.** Crack and crevice treatments in food preparation and service areas can provide good cockroach control. The insecticide must be applied where the insect lives. Therefore, most spray applications will be made to cracks and other harborages where cockroaches have been found during the survey. For this type of application use a low-pressure, fine-pin stream aimed directly into the crack. The angle of application is important because the greater the angle of the stream to the crack, the less the insecticide will penetrate. Crack and crevice treatment with pin-stream applications offers the additional advantage that the insecticide material is less likely to be washed away during routine cleaning procedures. Contact the local DOD Pest Management Professional for current recommendations on insecticide selection.

(b) **Aerosol Application.** Food service areas and other infested compartments can be effectively treated with aerosol crack and crevice sprays. The success of this method depends on proper insecticide dispersal equipment and the insecticide formulation. An example of this type of application would be a crack and crevice treatment using an aerosol formulation such as d-Phenothrin.

(c) **Bait Application.** Bait applications are an effective, environmentally sound method of cockroach control. Combat TM is a bait station, which can be used virtually anywhere for cockroach control. The bait is odorless, non-volatile, and does not product air contamination. The material works as a slow acting stomach poison and takes typically 1 to 2 weeks to affect control. It is contained in a tamper-proof bait station, which prevents exposure or accidental contact. Combat TM is also available in easy to use gel bait formulations for crack and crevice treatments. It is low in toxicity to humans and safe for use around sensitive electronic equipment. Insecticide baits can be used in fuse boxes, electrical outlets, around stoves, ovens, heaters, refrigeration units, food vending machines, behind false bulkheads, and enclosed motor areas. Baits can be used in all locations where liquids present the danger of electrical shorting or fire. Bait should be kept dry to be effective. Remove and replace as required.

(d) **Contact Powder Application.** Location and treatment is the same as with baits. Both aerosol spray and powder formulations of boric acid are available for cockroach control.

They are excellent for false bulkhead treatments and are long lasting, as the material does not chemically degrade rapidly if kept dry. This material also works as a stomach poison and can take up to weeks to control an infestation if used alone. Contact powder formulations are a good complement to Combat TM applications. This material can be used very effectively behind false bulkheads.

(e) **Frequency of Treatment.** One week after the initial residual treatment, a survey should be conducted and all active harborages retreated. Frequency of treatment is dependent on results from continued surveys. Insecticides should be applied only when and where needed, resulting in effective control with minimal contamination of the environment. Repeated control failures should be reported to the nearest military entomologist (articles 8-4 and 8-5).

(f) **Preparation of Spaces for Aerosol Treatment**

(1) The spaces to be treated shall be thoroughly cleaned. Particular attention should be paid to collections of grease on and around countertops, deep-fat fryers, vents, and food serving lines.

(2) Secure all areas to be treated and evacuate all unnecessary personnel except those conducting the spray operation.

(3) Put all exposed foods into protected compartments. Remove all cooking utensils from the space before treatment.

(4) Open all cabinet doors.

(5) Open all drawers in a stair-step fashion with the bottom drawer removed and placed on the floor.

(6) All hatches that do not have covers or cannot be adequately sealed must be fitted with a plastic or paper cover and taped.

(7) The electrician should then secure both exhaust and supply ventilation. Vent openings should be covered with plastic.

(8) Seal cracks, as well as doors that will not be used during the treatment phase, with masking tape.

(9) Post warning signs on all entrances to spaces under treatment.

(10) All pilot lights and other open flames must be secured before application. The operator must wear goggles, an approved respirator, gloves, and coveralls.

(g) **Treatment.** The actual treatment can only be accomplished by certified pest control operators.

(h) **Exposure time.** The airtight integrity must be maintained for at least 30 minutes and preferably 1 hour. Treated areas should be vented for 30 minutes prior to re-entry.

(i) **Post Treatment Cleanup.** Immediately following ventilation, all roaches and egg capsules should be collected and removed. This will serve to remove those cockroaches receiving sub-lethal dosages, and the egg capsules that the female while attempting to escape treatment frequently drops.

(6) **Supplies and Equipment.** Equipment required for operation and maintenance of a proper and safe cockroach control program includes the following items:

(a) One gallon, hand-compressed air sprayer.

(b) Spare parts for the sprayer.

(c) Approved respirator and refill cartridges.

(d) Neoprene or nitrile gloves.

(e) Goggles.

(f) Coveralls.

(g) Flashlight.

(h) Tools (screwdriver, wrenches, and pliers).

(7) **Nonstandard Methods and Materials.** OPNAVINST 6250.4 series requires all locally procured pesticides and equipment be technically reviewed and approved before procurement. Fleet units can obtain such approval from Navy entomologists stationed at any NAVENPVNTMEDU, DVECC, or from a NAVFAC field division applied biologist (see articles 8-4 and 8-5). Consult the Navy-wide Shipboard Pest Control Manual and NAVSUP Publication No. 486 for the correct procedures in procurement of pesticides and equipment to be used aboard ships.

e. **Cockroach Control in Naval Hospitals and Child Care Centers.** Cockroach control should be an integral part of a hospital pest prevention and control program. Cockroaches are only one of the many economically important vectors and pests, which justify a concerted, organized pest prevention and control program. The cumulative losses, damage, spoilage, and detrimental effects on health and welfare caused by pests and vectors represent a significant liability for the average Naval hospital or activity and justify the expenditure of funds for control. Special consideration should be given to the following:

(1) As a general rule, insecticides shall not be used in infant nurseries, operating rooms, pediatric wards, intensive care units, coronary care units, or other spaces where critically ill or debilitated patients are confined. Areas of this type should be kept free of insects by proper sanitation and construction. When insecticide treatment becomes necessary in such areas, temporary quarters shall be found for patients during the application and for a minimum of 4 hours after treatment to avoid solvent vapors. Only synergized pyrethrin and pyrethroid aerosols are currently recommended because they leave little residue, but will give immediate kill of all life stages except eggs. This treatment will not provide long-lasting control and frequent reapplications may be necessary. However, if a concentrated sanitary effort is combined with the use of residuals in surrounding rooms, effective control should result. The appropriate area entomologist can supply additional information regarding this type of control.

(2) Combat TM baits can be used for cockroach control in hospitals and childcare centers.

8-39. Stored Products Pests, Shipboard And Ashore

a. **General.** Stored products pests include more than 100 different species of insects, most of which are moths and beetles. They infest a wide variety of subsistence supplies including cereals, flour, farina, grits, candy, pet food, and any other non-canned food plus various animal fiber items, e.g., blankets, uniforms, and boots. Stored product pests are usually either rodents (see article 8-44) or insects. These stored products insects (SPI) include the saw-toothed grain beetle, flour beetles, warehouse beetle (Trogoderma), Indian Meal moth, and many others.

b. **Important References.** Military Standard (MIL-STD) 904B, DOD Standard Practice, Detection, Identification, and Prevention of Pest Infestation of Subsistence; Defense Supply Center Philadelphia Instruction (DSCPI) 4145.31, Integrated Stored Product Pest Management; Naval Supply Instruction (NAVSUPINST) 4355.6 series, Department of Defense Veterinary Food Safety and Quality Assurance Program; NAVSUP Pub 486, Chapter 5, Receipt, Inspection and Stowage; and the Navy-wide Shipboard Pest Control Manual are all important references concerning stored products pests.

c. **Detection of SPI**

(1) **Finding Infestations in Storerooms** is a tedious operation unless the insect populations are large enough to render the product unfit for human consumption (1-7 insects per pound depending upon the species) and spreading to other food products. Food items at highest risk include farina, grits, pet food, and any food that has been packed for at least 6 months.

(2) **Infestible Products.** It is essential that infestible products be checked upon receipt. Those near or past the inspection test date (shelf life) must be checked monthly to find the insects before they destroy the product and contaminate other products on the ship or in the storage facility.

(3) **Inspection Responsibilities.** Army veterinary food inspectors ashore conduct facility, vehicle, and product inspections. Aboard ship, the MDR is authorized and should conduct product (Class 9) inspections as per NAVSUPINST 4355.4 series, while the ship is not in port to extend shelf life as appropriate. Aboard ship, the MDR should conduct a stored product pest survey every month and appropriately log the results.

(4) **Pheromone and Food Attractant Traps.** Pheromones are chemicals secreted by an organism that cause a specific reaction by the other members of the same species. Because the pheromones are so specific, an entomologist needs to be consulted to determine if these traps are appropriate for a particular area and which traps should be used. Some of the traps for crawling insects also have a food attractant in them.

d. **Reporting Responsibilities.** All infestations must be reported. Check the NAVSUPINST 4355.4 series to determine if medical has the responsibility for your command and the appropriate reporting channel.

(2) DD 1222 (FEB 62), Request for and Results of Tests, must be submitted to the nearest entomologist, along with the insects to correctly identify the infesting insects and to document the occurrence of a product infestation. Submission of this report aboard ship is the medical department's responsibility. Further requirements and explanation of DD 1222 are found in MIL-STD 904 series and the Navy-wide Shipboard Pest Control Manual. This form is available at: http://www.dior.whs.mil/forms/DD1222.PDF.

(3) Suspected Hazardous Food Item message is required in addition to submitting a DD 1222 when insects are found in food. Directions on proper submission are found in NAVSUP Publication 486.

e. **Sanitation.** All broken containers, torn sacks, and spilled foodstuffs should be removed promptly; decks should be swept and vacuumed before receipt of new stores.

(1) Infested items must be isolated or promptly disposed of to prevent contamination of other materials.

(2) Spilled food is an open invitation to insects and rodents, it is the responsibility of inspectors to document every sanitation problem and for management to correct the deficiency.

f. **Insect Control.** Contact the area entomologist to determine if space treatment and/or residual pesticide application is appropriate for the particular storage area. Once a product is infested but still consumable, freezing it for 2 weeks will kill all life stages of the insects except the eggs. Allowable levels of infestations are outlined in MIL-STD 904 series.

8-40. Mites

a. **Relationship to Man.** Based upon their habitats, mites of medical importance may be classified into four groups: nest-inhabiting mites parasitic on birds and rodents, and which occasionally bite man, mites parasitic on animals and which occasionally bite man, mites parasitic on man, and food-infesting mites that occasionally bite man.

(1) **Nest Inhabiting Mites.** All of these mites live within the nests of birds and rodents and only bite man when deprived of their normal hosts. Medically, the house mouse mite is the most important member of this group, since it vectors rickettsial pox from mouse to man.

(2) **Mites Parasitic on Birds and Rodents.** These mites are parasitic on rodents, birds, and reptiles and the larvae may occasionally bite man. The term "chigger" is applied to the larvae of certain species of this group. Many of these species cause dermatitis to man, and a few transmit scrub typhus (Tsutsugamushi disease), a severe and debilitating rickettsial disease of man endemic to some land areas of the Far East.

(3) **Mites Parasitic on Man.** This group includes the well-known scabies or itch mite. The scabies mite is transmitted through close body contact and may appear wherever social conditions cause excessive crowding of people. This mite burrows in the horny layer of the dermis, causing an intense itching, especially at night, and occasionally erythema.

(4) **Food-Infesting Mites.** Many species of mites infest dry foods (e.g., bread, cheese, cereals, and smoked meats). Some of them can also cause a contact dermatitis to workers handling infested materials. These mites also have been associated with respiratory complications (e.g., asthma exacerbation or bronchial inflammation) when they or their by-product antigens are inhaled. There are also reports of urinary tract infestations that cause irritation, urethral stricture, and a predisposition to secondary infection. Ingestion of mite-infested food may lead to gastrointestinal disturbances.

b. **Biological Characteristics.** Mites can be recognized by the fact that they lack distinct body segmentation. They are usually very small, some being less than 0.5 microns (1/2000 of an inch) long. After hatching from the eggs, mites pass through three developmental stages: larva, nymph, and adult. The larva has six legs, while the nymph and adult forms have eight. In the species that transmit scrub typhus, the larval forms are parasitic on rodents, and incidentally parasitic on man. These larvae are quite small and usually red or pinkish in color. They feed on lymph and serous fluids and epidermal tissues, which are partially predigested by secretion of salivary fluids into the host's skin during feeding. The nymph and adult stages of these mites are free-living and feed on eggs of small insects and related invertebrates. The adult females oviposit on the ground. The larval chiggers are found most often in damp areas covered with vegetation such as margins of lakes or streams shaded woods and high grass or weeds.

c. **Control**

(1) **Nest-Inhabiting Mites.** Elimination of the house mouse mite and other important species of this group is principally dependent on host control. It may be necessary, in the case of infested structures, to apply residual sprays in the manner recommended for the interior control of flies and mosquitoes. If man regularly inhabits the structure, the application of residual insecticide should be restricted to infested areas only.

(2) **Mites Parasitic on Birds and Rodents.** The chiggers of these mites are of primary importance to man. Most are not disease vectors, but may be extremely pestiferous.

(a) **Protective Measures.** Personnel operating in an endemic scrub typhus area where chiggers constitute a health hazard should be required to use repellents and repellent impregnated clothing (article 8-47).

(b) **Control Measures**

<u>(1)</u> **Clearance of vegetation.** Locations used as campsites should be prepared as fully as possible before the arrival of occupying units. All vegetation should be cut or bulldozed to ground level and burned or hauled away. Chiggers customarily live only in damp shaded soil; therefore, procedures that expose the ground to the drying effect of sunlight will help to eliminate them. After a thorough clearing, the ground usually dries sufficiently in 2-3 weeks to kill the mites. Personnel engaged in clearing operations must use protective measures.

<u>(2)</u> **Use of Insecticides.** When troops must live or maneuver for periods of time in chigger-infested areas, it is recommended that area control with residual application of insecticides be accomplished. The effectiveness of any residual insecticides will vary with both the species of chigger and the area involved. Consequently, for adequate results, experimentation with materials and application rates may be necessary. Application can be achieved by using sprays, emulsifiable concentrates, wettable powders, or dust. With sprays, the amount of water needed, as a diluent will vary, depending on the per-minute output of the equipment used and on the kind and density of vegetation present. It takes approximately 50-1001 per hectare (7.5-10.5 gallons per acre) of diluted spray to treat turf or similar areas and approximately 2001 per hectare (21 gallons per acre) for thorough treatment of heavy vegetated areas.

(3) **Mites Parasitic on Man.** A medical officer should supervise control measures for scabies or itch mites, when practical. Control consists of treating infested individuals with a topical ointment or shampoo and heat sterilization of clothing and bedding.

(4) **Food-Infesting Mites.** Control of these mites is achieved by disposing of infested materials, sanitation of food storage and handling areas, and the use of effective residual sprays.

8-41. Ticks

a. **Relation to Man.** Ticks are annoying pests because of their bite and their ability to precipitate tick paralysis. Their greatest importance is related to the diseases they are known to transmit to man and animals. Some of the organisms causing disease include bacteria (tularemia, Lyme disease, Q fever, and endemic relapsing fever), rickettsia (Rocky mountain spotted fever, Lyme disease, and tick borne typhus), viruses (Colorado tick fever, Russian Spring-Summer encephalomyelitis, and Louping ill) and protozoa (babesiosis and anaplasmosis).

b. **Biological Characteristics.** There are four stages in the development of a tick: egg, larva, nymph, and adult. The eggs are laid on the ground, in cracks and crevices of houses, or in nests and burrows of animals. They may be laid in one large batch or in smaller groups. The period of incubation varies from 2 weeks to several months. The larval stage, identifiable by the presence of six legs, is very small upon emergence from the egg. Usually the larva requires at least one blood meal before it develops into the eight legged nymphal stage. All nymphs require at least one blood meal and one or more molts of the exoskeleton before the nymph undergoes metamorphosis to the adult stage. Some adult ticks require a blood meal before copulation while others do not. The two principle types of ticks are hard and soft ticks. The hard ticks, which include the genera Amblyomma, Boophilus, Dermacentor, Ixodes, Rhipicephalus, and others are identifiable by their distinct hard dorsal covering the scutum. They attach themselves to the host during feeding and remain there for a considerable period of time before engorgement is completed. The larva and nymph take only one blood meal each. The adult female takes a single blood meal before dropping off the host to digest the blood and lay a single large batch of eggs. Most hard ticks have either two or three hosts during their development.

The soft ticks have four genera, Antricola, Argas, Ornithodoros, and Otobius and lack a scutum. These ticks have much the same habits as bedbugs, hiding in cracks or crevices in houses or in nests of their hosts and coming out at night to feed on the blood of the host for a short period. The larvae and nymphs generally feed several times before molting. The adult female feeds a number of times, laying a small batch of eggs after each feeding.

c. **Control**

(1) **Protective Measures**

(a) Avoid infested areas whenever possible.

(b) Wear protective clothing such as: High-top shoes, boots, leggings, or socks pulled up over the trouser cuffs to help prevent ticks from crawling onto the legs and body. At the end of the day, or more often, the body should be thoroughly inspected for attached ticks, making sure that none have migrated from infested to fresh clothing or bedding.

(c) Personal application of the standard issue topical insect repellent is effective against immature ticks and to a lesser extent the adults. Uniforms treated with a Permethrin product are effective against all stages of ticks. See article 8-47 for details.

(d) All ticks found on the body should be removed at once. The best method for removing attached ticks is to grasp them with forceps at about a 45-degree angle from the skin. Pull them slow and steady until they release. Do not twist! Care should be taken not to crush the tick or to break off the embedded mouthparts that could be a source of infection. The wound should be treated with an antiseptic. Where hair is not involved, the use of tape is an effective means for removing tick larvae and nymphs from the skin.

(2) **Control Measures**

(a) **Clearance of Vegetation.** Clearing vegetation from infested areas will aid in the control of ticks and is recommended for bivouac and training grounds. All low vegetation should be uprooted with a bulldozer and burned or cut and hauled away.

(b) **Use of Insecticide**

(1) **Outdoor.** In situations where troops must live or maneuver for periods of time in tick-infested zones, area control by residual application of sprays, dusts, or granules should be achieved. The effectiveness of any insecticide will vary with both the species and the area involved. Experimentation with various dosages and materials may be required. Sprays should be made by mixing either an emulsifiable concentrate or a wettable powder and water. Oil solutions should be avoided because they cause plant damage. The amount of spray mixed will depend on the volume output of the equipment used and on the kind and density of vegetation to be sprayed. It takes approximately 1901 per hectare (20 gal per acre) of spray to treat lawns or similar areas, and 4751 per hectare (50 gal per acre) or more for thorough coverage of wooded or brushy areas. Vegetation should be sprayed at a height of 0.6 m (2 ft). Application rates for dusts will vary from approximately 2-5 kg per hectare (2-5 lb per acre), depending upon the insecticide and terrain. Insecticides should be applied as early in the year as ticks are noticed. One application may be effective for an entire season, but if ticks re-infest the area it may be necessary to repeat treatment.

(2) **Indoor.** The brown dog tick, Rhipicephalus sanguineus, frequently becomes established in dwellings and is difficult to control. A residual emulsion spray is the treatment of choice in this situation. Apply spray thoroughly to all possible harborages, including baseboards, around door and window

moldings, behind pictures, under furniture, around the edges of rugs, on curtain and draperies, and in all cracks. A second or third treatment may also be needed. Residual treatments in living spaces are to be made in infested areas only. This tick is usually introduced into living spaces by dogs; so control procedures should also include a thorough residual spraying of the spaces occupied by the dog at night, and a weekly treatment of the dog as directed by a veterinarian.

8-42. Fleas

a. **Relation to Man.** Like most other bloodsucking parasites, fleas have been implicated in the transmission of diseases. The oriental rat flea, Xenopsylla cheopis, is of great importance in the transmission of the plague bacillus which alone is sufficient to rank fleas among the more important insect vectors. Other genera of fleas transmit endemic or murine typhus and may act as the intermediate hosts for some parasitic worms. Gravid females of the "chigoe" or burrowing flea, Tunga penetrans, penetrate the skin to complete their development, causing ulcerating lesions on the feet of man and of animals. Fleas found outdoors are frequently referred to as "sand fleas;" however, they do not breed in the sand without animal hosts.

b. **Biological Characteristics.** Fleas are ectoparasites of birds and mammals. They are small, laterally compressed, hard-bodied insects that lack wings, but are equipped with legs especially adapted for jumping. The nest or burrow of the host is the breeding place and contains the egg, larva, pupa, and frequently the adult flea. The eggs are oval, pearly white, and dropped randomly on the ground, floor, or animal bedding where they hatch into larvae in a few days. Flea larvae are tiny, cylindrical, and maggot-like with either legs or eyes. They feed on organic matter and grow for about 2 weeks. When they are ready to pupate, the larvae spin silken cocoons that are somewhat viscid so that particles of dust, sand, and lint stick to them. Most fleas do not remain on their host continuously. Unlike most bloodsucking insects, fleas feed at frequent intervals, usually once a day. This is because fleas are easily disturbed while feeding and seldom complete a meal at one feeding. The "chigoe" flea is exceptional in that the fertilized female burrows into the skin of its host, particularly between the toes, under the toenails, and in the tender part of the feet. Here, nourished by the host's blood, the eggs within the female develop and the abdomen swells to almost the size of a pea. The posterior end of the flea lies level with the surface of the host's skin. The mature eggs are expelled through the ovipositor at the tip of the abdomen. The female then shrivels up and drops out or is sloughed during tissue ulceration.

c. **Control**

(1) **Protective Measures**

(a) Avoid infested areas when possible.

(b) Wear protective clothing or at least roll the socks up over the trouser cuffs to prevent fleas from jumping on the skin.

(c) Personal application of standard issue insect repellent is effective for short periods (see article 8-47).

(2) **Treatment of Breeding Areas**

(a) In infested buildings, apply residual sprays as emulsions or suspensions on floors, rugs, and on wall surfaces to a height of about 0.6 m (2 ft) above the floor.

(b) Flea-infested areas such as yards and under buildings should be treated with a residual emulsion. To prevent entries into structures, spray the foundation to a height of 0.6-0.9 m (2-3 ft). Vegetation should also be treated to a distance 1.5 m (5 ft) from the base of the foundation.

(c) When flea-borne diseases are present, rat burrows should be dusted with an insecticide prior to conducting rodent control measures. This prevents fleas from leaving dead or trapped rats and migrating to other animals or human hosts in the area.

(3) **Treatment of Infested Animals.** Because indoor flea infestations normally originate from pets, a program for controlling such infestations must include treatments of these pets. Dogs and cats are best treated under the care and direction of a veterinarian. Bedding used by pets should be simultaneously treated.

8-43. Reduviid Bugs

a. **Relation to Man.** Reduviid or cone-nose bugs of several genera, Panstrongylus, Rhodnius, and Triatoma, are important to man as vectors of the protozoan parasite, Trypanosoma cruzi, which causes Chagas' disease or American Trypanosomiasis. These insects occur in South and Central America, Mexico, and in the Southwestern United States. The infected insect bites man, defecates during feeding or soon afterward, and the infected feces is introduced into the bite by scratching or rubbing. Infection can also take place through contamination of the conjunctive, mucous membranes, wounds, or scratches.

b. **Biological Characteristics.** Human biting reduviid bugs are nocturnal, blood-sucking insects that are about 13-19 mm (1/2-3/4 in) in length. The anterior half of the wing is leathery and the posterior half membranous; the head is cone-shaped with a proboscis divided into three sections which are folded under, between the front legs; and the abdomen is flared out and upward to form a depression for wings. The stages of the life cycle consist of an egg, nymph, and adult. The nymphs are similar to the adults except for being smaller and having underdeveloped or partially developed wings. The eggs are barrel-shaped and are deposited in dusty corners of houses or in nests and burrows of animal hosts. The young nymphs hatch from the eggs to obtain blood meals from their hosts and shed their skins, developing into larger nymphs in the process. This is repeated through five nymphal stages to the adult stage. The entire life cycle requires 1-2 years. The normal hosts of these insects include rodents, bats, armadillos, and sloths. To man, their bite is usually painless and will not disturb a sleeping person. There is usually no reaction to the bite, but in some cases bitten individuals have experienced symptoms of dizziness, nausea, and intense itching on various parts of the body.

c. **Control.** Destruction of reduviid bugs is difficult. Screening and otherwise making dwellings insect proof can prevent their invasions. Nests of wood rats and other host animals should be eliminated in the general area of dwellings, particularly under structures. For chemical control, suspensions or emulsions should be used as a residual treatment on the interior walls and floors. Shelters or huts with palm-thatched roofs should be avoided as bivouac areas.

8-44. Rodents, Shipboard And Ashore

a. **General.** Rodents have associated with man for ages. Several species are particularly well suited for specialized conditions found both aboard ship and ashore. The distribution of rodents is worldwide; consequently, the problem of control presents itself during operations in any geographical location.

b. **Relation to Man.** Rodents such as rats, mice, and ground squirrels may serve as reservoirs for plague, endemic typhus, tularemia, and other debilitating diseases. The problem of contamination of supplies and direct property damage by rodents may also be considered.

c. **Important Species.** The semi-wild forms, which live in the jungles, forests, and wastelands, have little or no contact with man and are relatively unimportant in rodent control. However, military operations and occupation may change this situation. The most important rodents from the medical and economical viewpoint are:

(1) **Norway Rat.** The Norway, brown or gray rat, Rattus norvegicus, is a comparatively large animal, weighing approximately 280-480 gm (10-17 oz), with a tail that does not exceed the combined length of head and body. This rat is present wherever human activity creates suitable harborages and there is an adequate food supply. It prefers to burrow for nesting and is mainly found in basements, embankments, on lower floors of buildings, in drains and sewer lines, and in the holds and decks of ships. Preferred foods include meat, fish, or flesh mixed with a diet of grains, vegetables, and fruit. In the absence of these, any foodstuffs may be eaten.

(2) **Roof Rat.** The gray bellied, Alexandrian or roof rat, Rattus rattus alexandrinus is a good climber and may be found living in trees, vines, building lofts, overhead wiring, and upper decks of ships. The body is generally elongated, the ears are long and the tail exceeds the combined length of the head and body. There are many color and body-type variations. The black or ship rat, Rattus rattus, a subspecies variant of the roof rat, Rattus rattus alexandrinus, is an excellent climber and is frequently found on ships. These rats prefer seeds, cereals, vegetables, fruit and grass, but may subsist on leather goods, chocolate, and even weaker members of its own kind.

(3) **House Mouse.** The house mouse, Mus musculus, is commonly associated with man and may cause serious damage to foodstuffs and other valuable materials. Various species of field mice may on occasion enter habitations in search of food and shelter, but they do not present a major problem.

d. **Control and Prevention of Rodents Ashore.** Rodent control programs should include elimination of food and shelter, rodent proofing of structures, use of rodenticides, and glue boards and snap traps.

(1) **Elimination of Food and Shelter.** Proper handling of food and prompt disposal of garbage keeps food from being available and is important in rodent control programs. Food storage structures should be completely rodent-proofed. All supplies should be stockpiled on elevated platforms so that no concealed spaces exist. Garbage should be put in tightly covered containers, which should be placed on concrete slabs or platforms, and the area should be frequently and carefully policed. If wet garbage must be placed in landfills, the refuse should be completely covered to prevent its use as a feeding source for rodents.

(2) **Rodent Proofing.** Rodent proofing is not generally feasible for troops in the field. However, where structures are built, all necessary openings should be covered with 28 gauge, 95 mm (3/8 in) mesh galvanized hardware cloth, doors should be self-closing, tight-fitting, and if giving access to galleys and food storage rooms, equipped with metal flashing along the base. Walls and foundation should be of solid construction.

(3) **Rodenticides.** For destruction of rodents in camp areas, the use of rodenticides can be effective. Because most rodenticides are toxic to man and domestic animals, they should be used only by appropriately trained personnel. Single dose anticoagulant compounds are the rodenticides of choice under most conditions. These materials prevent blood clotting and cause capillary damage, which leads in most cases to internal hemorrhage, resulting in death. At concentrations recommended for rodent control, most anticoagulant agents are not detectable or objectionable to rodents. Brodifacoum and bromadiolone are two examples of single dose anticoagulants.

(a) Adequate exposure to anticoagulant baits is contingent on the establishment of a sufficient number of protected bait stations. This can be accomplished by placing tamper-proof bait boxes in rooms or areas where there is a potential for rodent activity. Every container of poisoned bait should be labeled POISON with red paint in English and in the local language if in a non-English speaking area.

(b) The frequency of bait station inspections and bait replenishments depend upon the degree of infestation encountered. The length of time required for rodent control will vary generally from 1 week to a month depending upon the availability of alternative food supplies and other factors.

(c) Baits should be kept dry during use to maintain maximum acceptability and toxicity. Where premises are particularly vulnerable to reinvasion, it is often practical to maintain tamper-proof bait stations after control has been attained. Maintenance of control is obtainable as long as sufficient bait is maintained.

(d) In tropical and semitropical areas where rodent infestation is commonplace and not confined to buildings, control efforts must include areas surrounding the buildings. Basically, the same exposure technique should be used in employing baits for indoor control. The main difference is that a larger number of bait placements should be made in areas where the rodents are known to feed.

(4) **Snap Traps and Glue Boards.** These have shown to be effective in markedly reducing infestations when placed properly in the area of rodent activity. Placement should be the same for both types of rodent traps. It is frequently effective to use snap traps in conjunction with glue boards.

(a) Rodents, being creatures of habit will frequently avoid the traps as new items in the environment. Tests show that within 2-3 days, these traps are accepted as part of the environment. This technique is especially effective if the traps are unset and baited with food. Bait the traps with food items the rodents have been observed feeding on in the area of the infestations. All trap baits should be wrapped in 5 cm (2 in) gauze squares before attachment to the trigger to prevent removal of the bait without springing the trap. This is when the traps should be set to spring, not before. The catch is usually excellent the first and second nights.

(b) Traps should be tied to overhead pipes, beams or wires, nailed to rafters, or otherwise secured wherever black greasy rub marks indicate runways.

(c) On the ground, rodents normally run close to the walls. Consequently, the traps should be set at right angles to the rodent runways with the trigger pans toward the bulkhead. Boxes and crates should be positioned to create passageways where the rodents must pass over the traps. They also should be placed so as not to be visible from the passageway entrance.

(d) Although unbaited traps with the trigger pan enlarged with a piece of cardboard or lightweight metal may be used in narrow runways, trapping is usually more effective when accomplished with baited triggers. Preferred trap baits vary with the area and species of rodent involved, and include bacon rind, nuts, fresh coconut, peanut butter, raw vegetables, and bread or oatmeal dipped in bacon grease.

(e) Service all traps regularly to remove rodents and replace the bait.

(f) For infestations not controlled by trapping, contact a Navy entomologist or applied biologist.

e. **Control and Prevention of Rodents Aboard Ship.** Shipboard rodent control programs should include proper sanitation, pierside inspections, use of rat guards, illumination and movement restrictions, and glue boards and snap traps.

(1) **Sanitation.** The elimination of food and shelter through proper handling of food and prompt disposal of garbage and rubbish will reduce the attractiveness of the ship to rodents.

(2) **Pierside Inspections.** Inspections of all subsistence items and cargo for rodent signs, such as droppings, hair, and gnawing or live rodents are essential in attempting to maintain a rodent free ship.

(3) **Use of Rat Guards.** Foreign quarantine regulations require that rat guards be used by naval vessels when berthing in ports where plague is endemic to prevent introduction of rodents on the ship. Rat guards should be a minimum of 36 inches in diameter and mounted at least 6 feet from the closest point to the shore or 2 feet from the ship. Specific Atlantic and Pacific Fleet instructions apply.

(4) **Illumination and Movement Restrictions.** Rodents are basically nocturnal. Therefore, gangways and landing ramps shall be well lighted at night to discourage rodent movement aboard. Gangways and other means of access to the vessel shall be separated from the shore by at least 1.8 m (6 ft) unless guarded to prevent rodent movement. Cargo nets are similar devices extending between the vessel and shore and must be raised or removed when not in actual use.

(5) **Rodent Control.** Glue boards and snap traps are the method of choice for rodent infestations aboard ship. The methods on ship are the same as that ashore. On the deck, glue boards or snap traps should be set behind objects that are stacked close to a bulkhead, along rows of boxes, and between crates and barrels forming runways. The traps should be set at right angles with the trigger end toward the bulkhead. They should be tied or nailed down to prevent an injured rodent from crawling off. All trap baits should be wrapped in 5 cm (2 in) gauze squares before attachment to the trigger to prevent removal of the bait without springing the trap.

(6) **Deratization Certification.** A certificate of Deratization (rat-free) or a Deratization Exemption Certificate is required for naval vessels entering most foreign ports. Requirements for this certification are detailed in BUMEDINST 6250.14 series, Procurement of Deratting/Deratting Exemption Certificates.

8-45. Insect Control on Submarines

a. **General.** The exclusion and sanitation measures detailed for insect control on surface vessels apply for submarines. However, eradication of an established infestation presents a special problem because repeated residual treatments with insecticides may produce undesirable air contamination.

b. **Residual Insecticides.** In most cases, the use of residual insecticides is the method of choice for insect control in submarines. However, residual insecticide application is authorized only when in port and when outboard ventilation for a minimum 24 hours is possible. Residual insecticides authorized for use on submarines are:

(1) Combat TM bait stations can be used for cockroach control aboard submarines while underway. The bait is odorless and nonvolatile, and does not produce air contamination. It is contained in a tamper-proof bait station that prevents exposure or accidental contact. It is low in toxicity to humans and safe for use around sensitive electronic equipment.

(2) Synthetic pyrethroid (2.0% d-Phenothrin) is a low-pressure aerosol in a hand held, non-refillable container. This material can be used as both a flushing agent to determine the extent of cockroach infestations and a residual crack and crevice treatment. D-Phenothrin can be used only when the boat is in port and is not expected to submerge for a period of 24 hours after application. The boat's exhaust air must either be discharged overboard or used by the engines for a period of 24 hours following application.

(3) Insecticides and equipment must ***not*** be transported or stored on submarines, with the exception of Combat bait stations (up to 144 stations may be onboard). The respective submarine tenders maintain a supply of insecticide and insecticide dispersal equipment.

(4) Personnel responsible for application and storage of materials must be certified pest control operators as per BUMEDINST 6250.12 series.

8-46. Common Venomous Arthropods

a. **General.** Injury produced by venomous arthropods is more common than generally realized. Millions of people in the United States are affected by these arthropods each year. About 25,000 of these envenomizations result in severe injury and about 30 result in death. This mortality contrasts markedly to the usual 14 deaths per year that are caused by poisonous reptiles. Clinical manifestations associated with envenomization include anaphylactic shock, hemolysis, necrosis, paralysis, cardiopulmonary dysfunction, allergenic asthma, and antigen induced dermatologic manifestations.

b. **Venoms.** Venoms produced by arthropods are mixtures of four toxic types: vesicating (blister beetles), neurotoxic (black widow spiders), cytolytic (brown recluse spider), and hemolytic (horse flies).

c. **Venomous Arthropods of Importance**

(1) **Centipedes.** Centipedes are fast moving, dorsoventrally flat, elongate arthropods having one pair of legs per body segment. All centipedes contain venom-producing glands that are connected by tubes to claws that are modified appendages on the first body segment. The potential for these arthropods to inflict injury on man is contingent on the size of the claw and its ability to penetrate the skin. Injected venom causes a considerable amount of pain, but rarely death. When death occurs, it is believed to be a result of an anaphylactic reaction. The wound should be disinfected and a medical officer consulted.

(2) **Millipedes.** These arthropods are slow moving, rounded, elongated arthropods with two pairs of legs per body segment. Many millipedes exude a vesicating fluid and may cause injury to persons handling them. Some are capable of squirting vesicating venom some distance and may cause severe injury to the eyes as well as the skin.

(3) **Scorpions.** Scorpions are venomous arachnids that rarely sting man, and then, only when provoked. Although few species are deadly, all stings should be considered dangerous because of the hemolytic and neurotoxic venom properties. The signs and symptoms associated with these stings vary with species and may include tachypnea, tachycardia, nausea, glycosuria, epigastric pain and tenderness, excessive salivation, slurred speech, tissue discoloration, and necrosis. The ground scorpions have a predominantly hemolytic toxin that is generally associated with swelling and except in the young, old or debilitated, death is uncommon. On the other hand, the venom of bark scorpions has a dominant neurotoxin that does not cause swelling and is more often associated with death.

(4) **Spiders.** Spiders are venomous arachnids and in most cases are considered to be beneficial because they feed on other arthropods. Bites of black or brown widow spiders (Latrodectus mactans and Latrodectus geometricus respectively), and the brown recluse spider, Loxosceles reclusa, are serious and of considerable medical importance. The venom of the Latrodectus spp. is strongly neurotoxic, causing severe symptoms of extreme pain, abdominal cramping, profuse perspiration, respiratory duress, and speech inhibition. Only 5 percent of untreated cases are fatal. The venom of L. reclusa is strongly hemolytic and vesicating, causing progressive tissue necrosis.

(5) **Blister Beetle.** When these beetles are touched, they exude a drop of vesicating fluid through the membranes of the appendage joints. The active ingredient of this fluid is cantharidin. Upon dermal contact, this fluid causes formation of serious blisters that eventually break, the released fluids causing satellite blisters. Bacterial secondary infection is common. Medical attention for affected individuals is considered important.

(6) **Hymenopterous Insects.** Member species of bees, wasps, yellow jackets, hornets, and ants are high in number and are the most

common sources of serious envenomization. The stings of these insects can be quite painful. Although the composition of hymenopterans venoms varies, most of them have a predominantly hemolytic factor associated with a smaller fraction of neurotoxin. Reactions between individuals exposed to a specific venom may vary considerably. For example, a bee sting may cause no effect or it may precipitate death. A serious manifestation of hymenopteran hypersensitivity is anaphylactic shock occasionally accompanied by regurgitation, encopresis, enuresis, rapid decrease in blood pressure, atypically slow pulse, prostration, debilitation and possibly death.

(7) **Caterpillars.** Caterpillars, the immature form of many species of Lepidoptera, may cause mild to severe contact dermatitis, nodular conjunctivitis, respiratory pain, headache and convulsions by injecting hemolytic venom into the skin by the tiny stinging (urticating) hairs that cover their bodies. These hairs may be present on not only the caterpillars, but on the egg covers, cocoons, and adults. The hairs may become airborne after being broken off, or be present in soil after the exoskeleton has been shed or the caterpillar is killed. An association with hairs from these sources can cause pulmonary inflammation and edema and/or dermal involvement. Injury by urticating caterpillars is seasonal, usually occurs in the spring, and is most common among children playing in trees or shrubbery. The most important species of these caterpillars in the United States are the puss caterpillar, Megalopyge opercularis; saddleback caterpillar, Sibine stimulea; range caterpillar Hemileuca olivaiae; crinkled flannel moth, Lagoa crispata; and the slug caterpillar, Adoneta spinuloides. Tape can be used to mechanically remove imbedded hairs or spines.

(8) **Allergens.** Insect allergens may be a significant causative factor in clinical allergic respiratory involvement, especially of the seasonal type, as shown by skin test reactions to insect extracts. Some insects associated with clinical conditions include mayflies and fungus gnats, which may cause asthma; caddisflies, which may cause asthma and coryza; and bees, which occasionally precipitate hypersensitive airborne particles. Aphids, beetles, and house flies may cause allergic rhinitis or asthma. Stored food insects may be a significant factor in mite dust allergy, while household insects may be a causative factor in house dust allergy.

d. **First Aid for Envenomization.** First aid for envenomization depends upon the nature of the venom, but the following general procedures are recommended:

(1) Take the victim to a physician immediately. If this is not possible, call a physician immediately for advice.

(2) If marked swelling or discoloration occurs at the site of envenomization, the venom is probably hemolytic, hemorrhagic, or vesicating. Keep the victim warm and quiet until a physician is consulted.

(3) If little or no swelling or discoloration occurs at the site of envenomization, the venom is probably neurotoxic. Apply ice to the site or, if possible, immerse the affected part of the body in ice water. Do not let the measures delay getting the victim to a physician.

(4) A physician must be reached if anaphylactic shock symptoms appear. During transportation or until medical assistance arrives, treat the patient symptomatically.

e. **Treatment of Envenomization.** Treatment of envenomization varies with the type of envenomization and the nature and severity of the symptoms. Neurotoxic envenomization is treated with specific antivenoms or with intravenously injected gluconate, epinephrine or adrenaline. Cytolytic envenomization often requires prolonged symptomatic treatment. Hemorrhagic envenomization, when severe, is treated with vitamin K. Urtication is treated by washing the skin with a bactericidal soap and a course cloth to remove any remaining hairs. Administer antihistamines. Vesicating envenomization is treated by draining the blisters with a sterile hypodermic needle, followed by application of magnesium sulfate compresses, and careful disinfection of the blisters to prevent secondary infection. Anaphylactic shock is treated by use of a tourniquet and subcutaneous injections of epinephrine. Allergic reactions are treated symptomatically with antihistaminic, adrenergic, spasmolytic, and anticholinergic drugs.

f. **Prevention of Envenomization.** Prevention of envenomization differs with the species of arthropod involved. The best technique is education, especially of children, to avoid venomous forms. The information given should be pertinent to the biology of the venomous species. For example, individuals hypersensitive to stinging Hymenoptera should wear light colored, smooth fabrics, and avoid leather or suede. It is advisable to keep hair covered, avoid scented cosmetics, stand still when approached by bees, wasps, or hornets, and confine outdoor activity as much as possible to times when temperatures are below 15.6 degrees C. (60 degrees F.).

g. **Control of Venomous Arthropods.** Specific residual insecticides are recommended for control of venomous arthropods. However, control of infestations of venomous species frequently requires special considerations because of their diverse nesting habits. Consequently, it is recommended that the area entomologist be consulted when control measures are being considered.

8-47. Use of Repellents

a. **Purposes.** Most repellents act as contact materials, keeping insects from biting when they touch the protective chemical with their mouthparts or feet. Some repellents may be sufficiently volatile so that insects refrain from coming close to the treated surface. Repellents may be used as undiluted liquid concentrates or formulated as solutions, emulsions, creams, lotions, powders, solid stick forms, or aerosols. Repellents offer protection from bites of mosquitoes, blackflies, biting gnats, biting midges, and fleas and may provide some protection against ticks, larval and adult mites. Repellents are designed primarily to repel biting insects and are not generally effective against the venomous arthropods.

b. **Protection Time.** The period of effectiveness of repellents varies with environmental conditions, concentration of the active ingredient, arthropod species, and activity of the treated person. Repellents are removed from the skin by absorption, evaporation, abrasion and dilution by perspiration. Consequently, the period of effectiveness is considerably reduced through strenuous activity, especially in warm humid weather. Clothing repellents may remain effective for several weeks depending on leaching due to washing, dry cleaning, rainfall, and perspiration among other factors.

c. **Personal Application Repellents**

(1) **Lotion.** Insect repellent, Personal Application, 3M, NSN 6840-00-284-3982. This repellent is packaged in 2 oz. tubes and contains 33 percent DEET. This lotion may damage lacquer, paint, and some plastics. A small quantity is squeezed from the tube into the palm of the hand. The palms of the hands are rubbed lightly together with a washing motion and rubbing then covers the arms. If long-sleeved shirts are worn, the repellent should be applied to the underside of the arms and under the cuff. Additional repellent is then placed into the palm and the procedure is repeated, carefully applying repellent to the exposed areas of the body. The repellent will cause a burning/drying sensation if allowed to contact mucous membranes; consequently, repellents should ***not*** be applied near the eyes or the lips. Continued exposure of repellents in the folds of the axilla, elbow, and knee will often produce dermal irritation in hot, humid conditions. The back of the neck, ears, and the hairline should be coated carefully. It is important that if a shirt is being worn, that the repellent be especially applied to the neck under the collar and particularly low on the neck if a collar is lacking. Any dermal area

that is not treated is subject to attack. When DEET is used, supplementary applications may be necessary every 6 to 10 hours, depending upon loss through sweating, wading in streams, contact with wet foliage, and similar activities.

(2) **Clothing Application Repellents.** Permethrin clothing-applied repellent may be applied by aerosol can, NSN 6840-01-278-1336, or as an emulsifiable concentrate, NSN 6840-01-334-2666. Material is applied by sprayer to the outer surface of clothing. All individuals may apply the aerosol; only a DOD certified pesticide applicator may apply the concentrate. On clothing, permethrin remains effective for up to 6 clothes washings with the aerosol formulation and up to the life of the clothes (1 year of field battle dress uniform use) for the emulsifiable concentrate formulation. Used in combination with DEET and with the proper wear of the uniform (sleeves down, collar buttoned), permethrin clothing treatment provides the most effective means of pre-venting bites from most bloodsucking arthropods.

d. **Additional Information on Personal Repellent Use.** Information can be found in the Armed Forces Pest Management Board Technical Guide No. 24, Contingency Pest Management Pocket Guide, this guide is available at: http://www.cdmha.org/toolkit/cdmha-rltk/PUBLICATIONS/ tim24_25jul2000.pdf; and Armed Forces Pest Management Board Technical Guide No. 36, Personal Protective Measures Against Insects and Other Arthropods of Military Significance, this guide is available at: http://www.afpmb.org/coweb/guidance_targets/ppms/TG36/TG36.htm.

SECTION VII. DISINSECTION OF NAVAL VESSELS AND AIRCRAFT CARRYING PESTS

8-48. General

Disinsection (elimination of insects) on vessels and aircraft is defined in Secretary of the Navy (SECNAV) Instruction 6210.2 series, Quarantine Regulations of the Armed Forces and encompasses procedures to prevent the transfer of live disease vectors from infested to non-infested areas. Disinsection should always be accomplished on leaving ports and airports where yellow fever, malaria, or plague is endemic. The World Health Organization (WHO) and the Centers for Disease Control (CDC) and Prevention of the U.S. Public Health Service determine disinsection requirements. Commanding officers should be aware of and comply with all applicable domestic and foreign quarantine regulations.

8-49. Disinsection of Vessels

Disinsection of vessels is always performed on those vessels departing foreign ports where vector borne diseases, including yellow fever, malaria, and plague are endemic or epidemic in the immediate port area. After leaving these areas, the medical officer or the medical department representative trained in shipboard pest control procedures should make a survey to determine whether insects capable of transmitting disease are present aboard the vessel. If disease vectors are present, the commanding officer must be notified and suitable disinsection procedures initiated. Such procedures include elimination of all standing water sources where mosquito breeding occurs, space treatments with aerosols, or residual application of pesticides. Information on materials and methods for the control of disease vectors and pests aboard naval vessels is found in Section VI.

8-50. Disinsection of Aircraft

a. **Geographic Areas Affected.** All aircraft, except that part of the cargo section treated following retrograde cargo handling procedures, operated or under the command jurisdiction of the Department of Navy, should be disinsected immediately before the last takeoff prior to entering the following areas:

(1) The United States or its possessions from a foreign port between 35 degrees north and south latitude. Aircraft landing in the United States north of 35 degrees north latitude need not be disinsected unless the aircraft proceeds immediately to an area south of 35 degrees north latitude.

(2) A foreign area according to requirements of that country.

(3) The State of Hawaii, including flights originating in the continental United States.

b. **Serialize and Log.** Aircraft disinsected for official record.

c. **Materials.** Insecticide aerosol, d-Phenothrin, NSN 6840-01-067-6674, is used to disinsect all aircraft arriving in the United States from a foreign country located within quarantine areas. Aircraft proceeding from quarantine areas within the United States to a foreign country or between foreign countries should also be treated.

8-51. Methods

a. The aerosol should be uniformly dispersed throughout the space to be treated by directing it toward the ceiling of the compartment.

b. Baggage compartments, wheel wells, and other areas where insects may find shelter on the outside of the aircraft should be sprayed after loading and boarding operations are completed and just prior to departure.

c. On passenger carrying aircraft, cover or store all exposed food, food preparation and service areas, and cooking and eating utensils. After all passengers and crew are aboard, close all doors, windows, hatches, and ventilation openings. Spray the cabin, cockpit, and other compartments accessible from within the aircraft. The aircraft should not be opened again prior to takeoff.

d. Where it is not feasible to carry an aerosol container on board an aircraft, the interior shall be sprayed just prior to takeoff. This applies primarily to one and two crew type aircraft.

8-52. Special Problems

a. If a question arises as to whether disinsection has been successful or whether a special problem of insect infestation exists that is not amenable to disinsection procedures herein recommended, a request for assistance should be made by the vessel or aircraft commander.

b. This request should be to quarantine officials at the sea or airport upon arrival or to the area DVECC or NAVENPVNTMEDU. The PHS Foreign Quarantine Branch may require disinsection beyond those of standard directives if an unusual or emergency situation exists.

8-53. Quarantine Procedures

a. Quarantine procedures include measures designed to prevent dissemination of disease organisms infective to plants, animals, and/or man. Basic regulations and detailed instructions concerning quarantine procedures are presented in SECNAVINST 6210.2 series.

b. By international convention, a Certificate of Deratization or a Deratization Exemption Certificate is required of vessels entering most foreign ports. The PHS or its appointed representatives can only issue a valid certificate.

SECTION VIII. PESTICIDE DISPERSAL EQUIPMENT

8-54. Equipment Availability and Suitability

a. The requirements for pest control equipment are numerous because of the variety of organisms, their habitat, and the types of control agents that are to be dispersed. Depending on the control problem, pesticide dispersal equipment is available for meeting the needs of confined or broad areas, whether the requirements call for stationary, portable, vehicular, or aerial equipment use. Because equipment types are continually being modified or developed to meet specialized or changing needs, it is essential to contact the appropriate medical entomologist or applied biologist for recommendations regarding the most appropriate equipment, as well as its authorized use.

b. Article 8-11, Pesticide Formulation and Dispersal, discusses formulations of pesticides, i.e., emulsions, suspensions, granules, etc., and types of pesticide dispersal, i.e., gases, aerosols, sprays, etc. Table 8-2 is provided for quick reference (see next page for table) on equipment types, formulations applicable, and best scenarios for use. Additional information regarding the use of equipment in the application of specific formulations, types of dispersal equipment, accessory platforms – vehicles or aircraft – required for transportation, advantages and disadvantages of each is discussed in this section.

c. There are several factors used in determining which spray system will be used for a spray mission. The target area to be sprayed, its size, location, habitat, and accessibility are considered when determining which spray equipment should be used. The size of the area will determine how quickly it can be sprayed, if it can be achieved on foot, or if it requires ground transportation. The location may be adjacent to an environmentally protected area, requiring greater drift control that may eliminate the use of aerial spray application. If the habitat has thick vegetation, ULV penetration will be greatly reduced, thus making a residual treatment more effective. The target area may not be accessible by road or it may contain numerous flooded acres that cannot be penetrated by ground vehicles, thereby necessi-tating the use of aerial or manual sprayers. The availability and schedule of the required vehicle or aircraft is another important factor. For example, mosquito control is generally most effective from dusk to several hours after dark. If the desired vehicle or aircraft is available for spray missions at different times, vector control effectiveness will be greatly reduced, possibly necessitating alternative application methods.

Table 8-2. Pesticide Dispersal Equipment and Their Uses

Dispersal	Formulations	Treatment	Advantages and Equipment	Type Limitations
Hand-held dust applicators, hand-plungers, foot-pumps	D	Residual	Wt. and cube small. Good for small areas.	Large areas not rapidly treated.
Hand-compressed sprayer	S, E, LV	Residual	Versatile, durable 1 or 2 gallon. Wt. and cube small.	Large areas not rapidly treated.
Hand-held gas or electric ULV sprayers	ULV	Contact	Good for internal spraying.	Expertise needed for use.
Pneumatic backpack sprayers	S, E, LV	Residual	Versatile, durable.	Large areas not rapidly treated.
Gas-powered backpack sprayers	G, D, S, E, ULV	Residual, Contact	Good for barrier sprays.	Expertise needed for use.
Hydraulic sprayers	S, E, LV	Residual	Good for residual treatments.	Hard to transport (large size).
Vehicular-mounted ULV foggers	ULV	Contact	Treats large open areas.	Expertise needed for use.
Air Dispersal Equipment				
Dispersal	**Formulations**	**Treatment**	**Advantages and Equipment**	**Type Limitations**
Navy PACU-9	ULV	Contact	Good for small acreage treatments.	No dedicated aircraft or crew.
Army PDU (helicopter)	G, LV, ULV	Contact	Good for small acreage treatments.	No dedicated aircraft or crew.
Air Force MASS (fixed wing)	LV, HV, ULV	Residual, Contact	Fixed wing; dedicated and trained crews. Good for large acreage treatments.	No limitations.

Formulation:

G	=	Granuale	LV	=	Low Volume
D	=	Dust	HV	=	High Volume
S	=	Suspension	ULV	=	Ultra Low Volume Solutions
E	=	Emulsion			

d. Hand-held equipment is available in a variety of types designed for various formulations, from ULV to granules. This equipment is generally reserved for smaller areas, or areas not readily accessible to larger pieces of equipment requiring transportation. One advantage to using this equipment is that each piece can be manually carried for application in the target area. Secondly, the equipment is smaller, reducing the necessary cubic size and weight, which can be used for other surveillance or control equipment and consumables. However, application is limited to the accessibility of the target area to the applicator and the speed and width of the applied swath width.

e. Backpack sprayers are units mounted on backpack frames for ease of carry and usually gas-powered. Some hand-compressed backpack sprayers are available. Their application rate matches that of the hand-compressed sprayer, but a larger pesticide reservoir is available. Application with the gas-powered backpack sprayers can range from liquid residuals to dusts and granules. Some backpack manuals claim to achieve ULV aerosol, but dispersal rates and droplet sizes generally exceed those required for flying insect control, providing limited control. They are carried manually, but hearing protection, gasoline, and engine oil are required. Like the gas-powered, hand-held sprayers, two-stroke engine maintenance skills are required. A backpack sprayer has approximately a 2.5 gallon capacity, with the additional attachments that allow you to switch from wet to dry applications. The sprayer, spare parts, tools, and miscellaneous accessories usually fit in a six or eight cube authorized medical allowance list (AMAL) can. Where suitable roads are limited, but manpower is available, the backpack sprayer will have some advantages over the vehicular mounted sprayers.

f. Vehicular mounted sprayers are too large to be easily handled by one person. They are mounted or placed on a vehicle or trailer. ULV application is achieved by the cold or thermal foggers used in mosquito control. This method provides a contact pesticide control and leaves little or no residual. Hydraulic sprayers apply a high volume (HV) of residual as demonstrated for fly control at landfills, or residual treatment of vegetation for adult mosquito control or mosquito larvae breeding sites. Trailer mounted sprayers, such as the buffalo turbine, can be used for residual applications from mists for vegetation to granules for larval breeding sites. These larger sprayers are operated by either four-stroke engines or electric motors. A thorough understanding of the equipment is critical for operation, calibration, and maintenance. A vehicle or trailer is needed, including accessibility to the target area, either by road or terrain that allows wheeled vehicles. Some hydraulic sprayers have been mounted in boats for transportation along waterways or lakes. In this way, large areas may be sprayed quickly allowing for greater protection against disease vectors.

g. Air dispersal equipment allows for greater dispersal of pesticide over large areas quickly. However, aircraft capable of transporting the pesticide equipment must be available at the optimal times for effective vector control.

(1) **Helicopter Sprayers.** The Navy, Marine Corps, and the Army do not have dedicated helicopters for pesticide application. This must be coordinated with the squadron commanders. Orientation of the flight crews regarding proper aerial application and vector control procedures are essential to ensure effective pesticide application by air. These units are good for areas not easily accessible for vehicular sprayers, i.e., marshes or heavily wood areas, but too small to justify the Air Force fixed wing sprayer. However, if aircraft are not available, the units cannot be used.

(a) The Navy Pesticide Aerial Cargo Unit Number 9 (PACU-9) has a 60-gallon liquid capacity and primarily applies ULV. Depending on the pesticide application rate, up to 7,500 acres could be sprayed per tank. It is attached inside the aircraft with a 12-foot boom extending out the starboard cargo door. It is approved for H-1 and H-3 helicopter platforms, but any platform that uses Davis tie-downs and compatible electronics can be used. The PACU-9 relies on aircraft electrical power for operation.

(b) The Army Pesticide Dispersal Unit (PDU) has a 150-gallon capacity. As an underslung unit, it can apply ULV, HV, and solid formulations. It is self-powered by an 11 hp gasoline engine and can be flown from any helicopter with a cargo hook. Depending on application rate, up to 19,000 acres could be sprayed per tank.

(2) **Fixed Winged Sprayers.** The Air Force Modular Aerial Spray System (MASS) is the only authorized fixed wing aerial spray system in DOD. It is carried on dedicated C-130's with dedicated trained crews and has a 2,000-gallon capacity. It delivers ULV to HV, but has no solid formulation dispersal capabilities. This capability allows for extremely large areas, up to 250,000 acres, to be sprayed, but is not feasible or economical for small areas more appropriately sprayed with the helicopter sprayers.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION IX. COLLECTION AND PREPARATION OF SPECIMENS FOR SHIPMENT TO MEDICAL LABORATORIES

8-55. Introduction

a. **Insects, Other Arthropods, and Vertebrates of Medical Importance.** Whenever possible, specimens should be collected and identified. Specimen acquisition permits development of collections representative of all geographical areas where naval personnel are stationed. These collections then provide a reference source to determine whether, during subsequent surveys, new or existing specimens are found to have moved into or left a specific area. Also, due to geologic variations pertaining to control, the importance of accurate vector and pest species identification cannot be overemphasized.

b. **Data Requirements.** To ensure the scientific value of specimens, it is necessary to record all pertinent data at the time of collection. The minimum information that must accompany all specimens is the date collected, the precise location, and the collector. Other important information includes method of collection, elevation, host, habitat, behavior, time of day, specimen coloration, and any significant morphological or ecological observations. All associated data should be kept with the specimens as they are moved, mounted, studied, or shipped. Labels should be written with a soft lead pencil or pen with indict ink, and to avoid loss or switching, placed inside vials, Novocain tubes, or boxes with the specimens. With pinned specimens the labels should be mounted on the pins below the specimens.

8-56. Procedures

a. **Arthropods**

(1) **Dead Specimens.** When shipping material by mail, an advance letter should be sent to the addressee notifying him of the shipment and its content. The actual shipment, via parcel post, is marked “Dried (or Preserved) Insects for Scientific Study” and “Fragile.” If the shipment is from overseas the statement, “No Commercial Value” will facilitate passage through customs.

(2) **Live Specimens**

(a) **Quarantine and Shipping Regulations.** If live arthropods or arthropods containing infectious etiologic agents are to be shipped from overseas or interstate, permits may be required by PHS and/or the U.S. Post Office. To ensure compliance with regulations, refer to SECNAVINST 6210.2 series and BUMEDINST 6210.3 series, Handling and Shipping of Potentially Hazardous Biological Materials, Diagnostic Specimens, and Etiologic Agents.

(b) **Shipment.** Delicate insect larvae and adults cannot be easily shipped; therefore, the more durable eggs or pupae should be sent whenever possible. Shipments should be air mailed or sent by special delivery if necessary. Ventilate the package but make sure the insects cannot escape. Pack carefully and mark the package “LIVING INSECTS” so it will receive special handling. An advance letter should be sent to the addressee notifying him of the shipment and its content.

(1) **Unpinned specimens**

(a) **Mosquito larvae**

1) **Collection.** Mosquito larvae are collected to determine the species involved, breeding sites, and relative abundance. The tools used in collecting larvae include a long-handled white enamel dipper, a large mouth pipette, a piece of rubber tubing several feet long, a suction bulb, screw cap vials, pencil, paper, a flat white porcelain pan, and 70 percent ETOH. Collecting techniques vary with the species involved. For free-living species, approach the breeding site carefully because larvae are sensitive to vibrations and shadows. For Anopheline species, skim the surface of the water with the dipper. Culicine species are more active and a quick dipping motion with the dipper provides the best results with this group. For a control program, regular larval dipping stations are established so that the average number of larvae per dip can be used as an index of control effectiveness. Container, tree hole, crab hole, and leaf axil breeders can be collected with a pipette or aspirated with a suction bulb attached to a piece of rubber tubing. Mansonia and Coquillettidia larvae are collected by pulling up aquatic vegetation (sedges, cattail, etc.), which is rinsed in a pail of water. Since the larvae drop off of the plant quickly it may also be productive to scoop up samples of bottom sediment with a bucket and rinse this material with a strainer. Transfer the rinse and strained water in small amounts to a small porcelain pan and examine it closely for larvae.

2) **Curation.** Never mix specimens collected on different days or from different breeding sites. Concentrate all of the larvae from a single collection in 2.5 ml (1 in) of water in a small test tube, and heat it with a match or a Bunsen burner until bubbles begin to reach the surface. Pour the contents into a small open container. Pick up the larvae on the point of a probe or insect pin and drop them into a Novocain tube containing 70 percent ETOH. These tubes may be obtained from dental facilities. Isopropyl alcohol (70 percent) may be temporarily substituted as a preservative but it should be replaced with ETOH when possible to preserve specimen quality. Insert a small, loosely compacted piece of cotton into the tube at a point just above the larvae and well below the surface of the alcohol. Write the collection data with a soft lead pencil or pen with indict ink on bond paper labels. When using indict ink, allow the label to dry. Then push the label into the tube above the cotton. Insert the top Novocain tube stopper using a needle to release the compressed air. Make sure that no bubbles exist in the section of the tube holding the larvae because repeated passage of air bubbles over specimens can cause damage. One week following preservation, re-examine the tubes. If bubbles have formed, release the trapped air with a long needle. Wrap the tubes carefully in cotton or other soft packing material and package them in a crush-proof container for mailing.

(b) **Mosquito adults**

1) **Collection.** The collection of adults requires consideration of the species' behavior. Since no single method attracts all species, a combination of methods is desirable. Light traps attract phototrophic species. The New Jersey light trap is widely used for this purpose. Basically it is an open metal cylinder protected by a conical top. An electric fan draws the insects attracted to a 25-40 watt white light, into a collecting jar containing a piece of dichlorvos-treated resin strip or PDB. A perforated paper cup suspended from the rim of the jar keeps the mosquitoes dry, clean, and easy to remove. The fan in a New Jersey light trap requires 110 volts and can be turned on and off by an electric timer or photoelectric cell. Another type of trap is the CDC or Solid State Army Miniature (SSAM) light trap that weighs only about 0.8 kg (1/3 lb) and can be operated on any 6 volt DC source. The use of a 30-amps/hour-motorcycle battery gives up to 5 nights' operation without recharging. The live adults are collected in a cage of nylon netting and can be used in virus isolation studies. Proper trap placement is very important. Place the traps about 1.5 to 1.8 m (5 to 6 ft) above the ground, and avoid

competing light sources, windy areas, and industrial fumes. Also avoid trapping in livestock and bird roosting areas because mosquitoes are less easily attracted to light after taking a blood meal. Optimum results will be obtained in areas with adequate vegetation and high humidity. A shift of a few meters can make a substantial difference in results. Therefore, if trapping results are poor, change the trap locations before reporting the absence of mosquitoes in the area. In addition to indicating what species are present, trapping signals the emergence of males that emerge before the females and congregate near the breeding site. This allows treatment of a population before a major increase in the number of adult females occurs, thus, lowering the breeding potential. For some of the Anopheline species that are not strongly attracted to lights, collections are made at resting sites. This is done by sweeping the vegetation with an insect net or by using an aspirator (or killing tube) and a flashlight. The aspirator is made of rubber or plastic tubing joined to a piece of rigid clear plastic tubing [0.9 cm (0.37 in) inside diameter] with a piece of netting in between for a filter. Cool, dark, and humid areas are checked, including culverts, bridges, caves, overhanging stream banks, wells, and buildings. In areas with few resting sites a variety of artificial devices such as boxes, barrels, and kegs can be established. For a detailed discussion of mosquito collection, a "Mosquito Surveillance Guide" is available from EPMU's and DVECC's.

2) **Curation.** Adult mosquitoes are very delicate and must be handled carefully to avoid loss of scales or appendages essential to their proper identification. Natural scale discoloration, caused by moisture, must also be prevented. Consequently, to avoid contact with moisture that condenses in ethyl acetate or chloroform killing tubes when exposed to heat or the sun, remove the mosquitoes as soon as they are killed and periodically wipe the barrel of the tube dry. Reared adult specimens to be preserved should be kept alive for at least 12 hours to allow them to harden, and then pack them in pill boxes. Pillboxes are preferred over glass, plastic, or metal containers because they are permeable. This helps to prevent any fungal growth caused by a build up of excessive moisture from the drying specimens and heat from the environment. Prepare the box for shipping by cutting two strips of soft tissue paper slightly larger than the lid. Place a thin, very light wisp of cotton in the bottom of the box, and cover it with one paper slip. Being slightly larger than the box, the paper's tucked edges against the sides will hold it firmly. Place the collected mosquitoes on this paper and tuck in the second paper slip until it just contacts the mosquitoes. Be sure the covering slip will not become dislodged. Over the top paper slip, add another wisp of cotton that is barely large enough to touch the lid when it is closed. Do not, under any circumstances, pack mosquito adults between layers of cotton, cell cotton, or similar fibrous and heavy materials. The collection data should be placed within the container between the lid and the top layer of cotton. Data may also be recorded on the lid of the container. Placing the containers in an excelsior-padded and properly labeled mailing tube completes packing.

(c) **Flies.** Adult flies can be collected with an insect net or a variety of traps. If a natural attractant is available use a 76mm (3.0 in) diameter wire screen cone with an inverted screw top to trap domestic flies. Place the cone over the attractant and flies. Then place a dark cloth over the cone. The cone is then agitated and the flies will move upward toward the light in an effort to escape. The sliding door of the trap is then closed, blocking the mouth of the bottle. Lacking a natural attractant, all-purpose baits consisting of a mixture of fish heads, chicken entails, vegetables and fruit may be used. The cylindrical screen trap placed several inches above the bait should have a funnel shaped, upward pointing bottom, and a removable top. As the flies leave the attractant, they are funneled into the trap. Since they generally do not fly downward to escape and the funnel opening is difficult to find, few flies will escape. Fly larvae (maggots) and adult specimens of delicate flies, such as sand flies, culicoid biting flies, eye gnats and blackflies, may be preserved in 70 percent ETOH as described for mosquito larvae. Larger flies, such as domestic species, should be preserved in dry pill boxes as detailed above for mosquito adults, except that heavier cotton cushion layers will be needed because of the greater weight of the specimens involved.

(d) **Ectoparasites.** Particular effort should be made to collect ectoparasites from wild rodents suspected of being reservoirs of disease (e.g., plague, tularemia, etc.). Because fleas leave the host shortly after death, it is best to capture the animal alive and sacrifice it with chloroform in a closed container from which the detached insects can be collected. Leave the animal in the container at least 30 minutes after death to ensure that the ectoparasites have also been killed by the chloroform exposure. A fine-tooth comb is used to comb fleas onto white paper. Another technique for collecting fleas, as well as some mites, is to place the dead host in a jar of water containing a detergent and swirl the water vigorously. After filtering the water with a filter paper lined funnel, place the specimens in 70 percent ETOH as described for mosquito larvae. Neither combing nor detergent baths will remove stick-tight fleas or ticks. These must be picked off with forceps during a thorough host examination. When examining buildings for adult fleas, white pants or coveralls will allow the adults to be seen quite readily when they move onto the legs. They can then be collected with a small alcohol moistened brush. When examining animals for ticks, care must be taken in their removal so that the mouth-parts are not broken in the host's skin. Ticks may be collected from likely host habitats by walking through grassy or bushy areas and removing them with forceps from the clothing or from a piece of cloth used as a drag. The latter is constructed by attaching a piece of white flannel about 1 x 1.5 m (1 x 1.5 yds) by two corners to a stick approxi-mately 1m (1 yd) long. A cord is attached to both ends and the device is dragged over grassy areas beside trails and other potentially infested areas. The same device without the cord can be brushed over shrubbery. Collected ticks are placed in 70 percent ETOH. The detergent technique described for fleas yields some mites but chiggers are collected by scraping the skin or, in the case of dead animals, portions of infested skin may be cut off and preserved in alcohol. Another method is to place a white or black card on the ground. Mites are counted and/or collected with a small, alcohol moistened brush as they cross the card. Lice and bed bugs may be collected from clothing and bedding with forceps or combed from the hair with a fine-tooth comb and placed in 70 percent ETOH.

(e) **Miscellaneous Arthropods.** Insect larvae spiders, scorpions, centipedes and millipedes may be preserved in vials of 70 percent ETOH. When corks or rubber stoppers are used to close vials, it is best to seal them with melted paraffin or parafilm to prevent fluid loss through evaporation. If 5 percent glycerin is added to the 70 percent ETOH, the collected specimens will not shrivel, shrink, or dry if the alcohol is accidentally lost. Larger, hard bodied insects such as reduviid bugs, cockroaches and beetles should normally be preserved dry in pill boxes but they can also be placed in tubes or vials of 70 percent ETOH.

(2) **Pinned Specimens.** If possible, it is usually better to pin insects for mailing because they are less likely to break if properly packed. These specimens may be pinned inside a closed vial with a cork bottom or in a Schmitt, cigar or other sturdy box with a cork, balsa wood, corrugated cardboard or composition bottom. The pins should be securely anchored in the substrate. Large specimens should be braced with additional vertically placed pins to prevent them from rotating and destroying adjacent specimens. Insects with elongated abdomens should be supported with crossed pins, thereby preventing the abdomens from breaking off in the event of rough handling during shipment. For ease of extraction, the cardboard can be slotted or a piece of adhesive tape can be attached to the center for use as a handle. Fasten the lid securely and pack the box or boxes in an outer stout carton padded with a lining of excelsior, styrofoam or similar packing at least 5cm (2 in) thick.

b. **Vertebrates**

(1) **General.** Vertebrate specimens should be collected whenever proper identification is in doubt. Instructions for the collection and preservation of such specimens can be obtained from personnel at the nearest DVECC or EPMU.

(2) **Shipping packages of vertebrate specimens** should be marked "Skins of" or "Preserved for Scientific Study" if the specimens are in a preservative fluid. Parcels should clearly show any legal endorsements required by the state, territory, or district in which specimens are mailed (see article 8-56a(1) and (2) above). An advanced letter should be sent to the addressee notifying him of the shipment. All packages must be wrapped to prevent any fluids from leaking through the package and damaging other mail.

8-57. Disposition of Collections

a. Collection of specimens should be sent to the appropriate DVECC or EPMU for identification. Specimens that cannot be identified by the Center or Unit involved, or which are considered of sufficient significance for museum use, will be sent to the Navy Environmental Health Center Medical Entomologist for further study and disposition. Complete data should always accompany the shipments (article 8-55). An advance letter of shipment notification, an appropriate request for services, and any comprehensive and pertinent questions for which answers are specifically required should also be sent.

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER 8. NAVY ENTOMOLOGY AND PEST CONTROL TECHNOLOGY

SECTION X. APPENDICES

A. REFERENCES

Department of Defense

DOD Instruction 4150.7, DOD Pest Management Program is available at: http://www.dtic.mil/whs/directives/corres/html/41507.htm

DOD Instruction 4150.7-M, DOD Pest Management Training and Certification is available at: http://www.dtic.mil/whs/directives/corres/html/41507m.htm

DOD Instruction 4150.7-P, DOD Plan for the Certification of Pesticide Applicators is available at: http://www.dtic.mil/whs/directives/corres/html/41507p.htm

DSCPI 4145.31, Integrated Stored Product Pest Management is available at: http://www.dscp.dla.mil/subs/subsbo/qapubs/4145.31.pdf

MIL-STD-904B, DOD Standard Practice, Detection, Identification, and Prevention of Pest Infestation of Subsistence of 10 Mar 2000 is available at: http://www.vnh.org/PestControl/appg.html

DD 1222, Request for and Results of Test is available at: http://www.dior.whs.mil/forms/DD1222.PDF

Department of the Army, Navy, and Air Force

SECNAVINST 6210.2 series, Quarantine Regulations of the Armed Forces is available at: http://neds.daps.dla.mil/Directives/6210a2.pdf

Department of the Army, Navy, and Marine Corps

AR 40-70/NAVSUPINST 4355.6A/MCO 10110.44A of 1 Feb 95 is available at: http://www.usapa.army.mil/pdffiles/r40_70.pdf

Department of the Navy

OPNAVINST 5090.1 series, Environmental and Natural Resources Protection is available at: http://neds.daps.dla.mil/5090.htm

OPNAVINST 6250.4 series, Pest Management Programs is available at: http://neds.daps.dla.mil/Directives/6250_4b.pdf

BUMEDINST 6210.3 series, Handling and Shipping of Potentially Hazardous Biological Materials, Diagnostic Specimens and Etiologic Agents is available at: http://navymedicine.med.navy.mil/Files/Media/directives/6210-3.pdf

BUMEDINST 6250.12 series, Pesticide Applicator Training and Certification for Medical Personnel is available at: http://navymedicine.med.navy.mil/Files/Media/directives/6250-12c.pdf

BUMEDINST 6250.14 series, Procurement of Deratting/Deratting Exemption Certificates is available at: http://navymedicine.med.navy.mil/Files/Media/directives/6250.14a.pdf

NAVMED P-5010, Preventive Medicine Manual is available at: http://www.vnh.org/PreventiveMedicine/PreventiveMedicine.html

NAVSUP Pub 486, Chapter 5, Receipt, Inspection and Stowage is available at: (You will need to register for a password to access this publication.) http://nll1.navsup.navy.mil/nll/filedetail.cfm?id=5481

U.S. Navy Shipboard Pest Control Manual; available at: http://navymedicine.med.navy.mil/Files/Media/directives/5052-26.pdf

Armed Forces Pest Management Board

Military Pest Management Handbook; available at: http://www.afpmb.org/mpmh/toc.htm

Technical Guide No. 15, Pesticide Spill Prevention and Management is available at: http://www.afpmb.org/pubs/tims/tim15.pdf

Technical Guide No. 24, Contingency Pest Management Pocket Guide is available at: http://www.afpmb.org/pubs/tims/TG24/TG24.pdf

Technical Guide No. 36, Personal Protective Measures Against Insects and other Arthropods of Military Significance is available at: http://www.afpmb.org/coweb/guidance_targets/ppms/TG36/TG36.pdf

B. METRIC CONVERSION EQUIVALENTS APPLIED TO THE TEXT MATERIAL

1 centimeter (cm)	0.39 inches (in)	1 cubic centimeter (cc)	0.03 fluid ounces (fl oz.)
1 meter (m)	3.28 feet (ft)	1 millimeter (ml)	0.03 fluid ounces (fl oz.)
1 meter (m)	1.09 yards (yd)	1 liter (l)	0.26 gallons (gal)
1 knot	1.15 miles/hour	1 gram (g)	0.35 ounces (oz)
1 kilometer (km)	0.62 miles (mi)	1 kilogram (kg)	2.20 pounds (lb)
1 hectare	2.47 acres		

SECTION XI. ACRONYMS

AMAL	Authorized Medical Allowance List
BHC	Benzene Hexachloride
BUMED	Bureau of Medicine and Surgery
CDC	Centers for Disease Control
DDT	Dichloro-diphenyl trichloroethane
DEET	Diethyltouamide
DLA	Defense Logistics Agency
DOD	Department of Defense
DVECC	Disease Vector Ecology and Control Center
EPA	Environmental Protection Agency
FSSG	Force Service Support Group
HV	High Volume
IV	Intravenously
kg	Kilogram
LC50	Lethal Concentrations 50
LD50	Lethal Dose 50
MASS	Modular Aerial Spray System
MDR	Medical Department Representative
Mg	Milligram
MIL-STD	Military Standard
MTF	Medical Treatment Facility
NAS	Naval Air Station
NAVENPVNTMEDU	Navy Environmental and Preventive Medicine Units
NAVFAC	Naval Facilities Engineering Command
NAVSUP	Naval Supply Systems Command
NIOSH	National Institute of Occupational Safety and Health
OPNAV	Office of the Chief of Naval Operations
PACU-9	Pesticide Aerial Cargo Unit Number 9
2-PAM	Pralidoxime Chloride or Protopam Chloride
PCC	Poison Control Center
PDB	Paradichlorobenzene
PDU	Pesticide Dispersal Unit
PHS	Public Health Service
PMT	Preventive Medicine Technician
QAE	Quality Assurance Evaluators
SECNAV	Secretary of the Navy
SPI	Stored Product Insects
SSAM	Solid State Army Miniature
ULV	Ultra Low Volume
WHO	World Health Organization

Bureau of
Medicine and Surgery
Washington, D.C. 20372-5120

NAVMED P-5010-9 (6-91)
O51O-LP-O33-OO5O

Manual of Preventive Medicine

Chapter 9

Preventive Medicine for Ground Forces

DISTRIBUTION STATEMENT "A"

O51OLPO33OO5O

CONTENTS

Section VII. Disease Control

Appendices.

Illustrations.

CHAPTER 9
PREVENTIVE MEDICINE FOR GROUND FORCES

Section I. INTRODUCTION

9-1. Scope. This chapter provides technical guidance to preserve the combat readiness of Naval operational forces ashore by preventing illness and injury. When used with other chapters in this manual, this chapter provides valuable information for unit commanders and medical department personnel operating in field environments.

9-2. Mission. The primary mission of preventive medicine (PREVMED) personnel including unit Medical Officers (MO), Senior Medical Department Representatives (SMDR), Environmental Health Officers (EHO), and Preventive Medicine Technicians (PMT), is to preserve unit combat effectiveness by providing informed technical information to the Commanding Officer or Officer in Charge concerning preventive medicine and environmental health. This entails conducting sanitation and habitability inspections, advising the command concerning health risks affecting the command or unit, recommending actions to reduce health risks, and providing training to personnel in preventive medicine and other related topics. The primary mission remains the same regardless of the size of the operation.

9-3. Responsibility.

1. Unit commanders are ultimately responsible for the health and safety of their personnel.
2. Preventive medicine personnel are responsible for fulfilling their primary mission and providing additional general medical services to the supported element as operational situations dictate. Specific preventive medicine tasks include:
   a. Assist individual units to recognize and eliminate existing or potential health hazards.
   b. Perform or assist with epidemiological investigations of outbreaks or suspected outbreaks of communicable diseases.
   c. Arrange for laboratory support for epidemiologic investigations.
   d. Conduct sanitary surveys to identify potential sanitation problems and recommend corrective action.
   e. Establish an alert posture toward the early signs of communicable disease, particularly those endemic to the area of operation, and take immediate steps to isolate and treat cases.
   f. Provide inservice training to medical and nonmedical personnel concerning relevant preventive medicine topics.
   g. Provide assistance consistent with the PREVMED personnel expertise and resources in the event of an emergency or disaster.
   h. Conduct limited preventive medicine studies consistent with operational commitments.
   i. Draft instructions, notices, and other directives as appropriate, to convey preventive medicine and environmental health information and requirements.
   j. Establish and maintain liaison with other military, governmental and civilian agencies as appropriate to accomplish the mission.
   k. Provide consultation, training, and supervision for mass immunization programs.
   1. Compile and provide relevant medical intelligence briefings to the unit commander and to command personnel as appropriate.
   m. Provide unit commanders with timely status reports of preventive medicine programs and after action reports at the conclusion of operations or exercises.
3. All personnel must do all they canto preserve their own well being and promote the health of their unit or command by practicing good personal hygiene and following sound camp/field sanitation procedures.

9-4. Field Conditions. Medical department personnel must be aware of specific health problems that may arise due to the unique nature of conditions in which operational forces of the Navy and Marine Corps are involved. Field conditions vary greatly from one geographic locale to the next. From hot, dry desert climates to cold alpine or arctic conditions, necessities for the prevention of illness and injury in deployed troops may change dramatically. Requirements and methods for providing safe water, food, and waste disposal often change according to the specified environment. Field conditions in modern warfare can be altered rapidly and require foresight in order to deal with environmental stresses. Urban warfare may require troops to deploy into an area which previously had modern public utilities such as potable water lines, sanitary sewers and waste disposal. Overnight, an area such as this can change to an urban disaster area where all water, food, and services are suspect of contamination or do not exist.

9-5. Importance of Preventive Medicine.

1. Prevention of disease is one of the most important functions of any military medical service. In every war for which statistics are recorded, military forces have lost more personnel to disease than to direct combat with opposing forces. Table 9-1 illustrates the severe impact of disease on combat forces as a percentage of total admissions due to disease/non battle injuries (DNBI).

a. Heat and cold injuries can take heavy tolls on the battlefield. During the 1967 Arab-Israeli War, 20,000 deaths due to heat were reported when troops were isolated from their sources of water. Cold injuries caused over 90,000 hospital admissions in WWII. During the 24 day British invasion of the Falkland Islands in 1982, 14% (109) of the 777 British casualties were from cold injuries.

b. Arthropod borne diseases alone were responsible for the loss of over 16.5 million man-days among U.S. Armed Forces during WWII. Malaria incidence threatened the entire Asian-Pacific campaign, and in one instance in the Solomon Islands, caused eight times more casualties than the enemy.

c. Diarrheal diseases were influential in the defeat of Rommel's Army at El Alamien, North Africa in WWII. His top generals were medically evacuated just before and during the battle due to amoebic dysentery. Rommel himself was not present when the battle began due to hepatitis.

d. When U.S. Marines were first used as a stabilizing force in Lebanon in 1958, the force was almost completely incapacitated with dysentery within 2 weeks of entering that country. However, when U.S. Marines were reintroduced into Lebanon in 1982–83, the morbidity among Navy and Marine Corps personnel was dramatically reduced by application of environmental health controls. These controls included restricted access to local foods, close adherence to good food sanitation practices, extensive use of Meals, Ready to Eat (MRE), aggressive fly control programs, and application of proper water sanitation practices.

e. The significant benefits of preventive medicine were manifested again in the 1991 "Desert Storm" operations in Iraq and Kuwiat. Preventive measures resulted in record low morbidity. Heat, increased need for water, arthropod risks, and geographical isolation posed great dangers to troops. Predeployment education of the troops prepared individuals for the struggle against disease and non-battle injuries. The rate of hospital admission due to disease during Desert Storm was reported to be less than 50 per 1,000 patients. This is extremely low when compared to the 917 per 1,000 admissions attributed to disease in the Middle East theater during World War II. In stark contrast, Iraqi troops were found undernourished, without water, and covered with various lesions from insect bites and disease.

2. As the evidence shows, personnel operating in the field are at greater risk of communicable diseases and injury than in garrison. This can generally be attributed to three reasons:

a. Increased exposure to hazards. Military operations or exercises often take place in locations where personnel are exposed to disease carrying insects, polluted water and food sources, contagious local populations, hot conditions or extremely cold environments. Personnel must be prepared to function under such conditions.

b. Reduced resistance to disease. Personnel deployed to distant locations may experience loss of sleep, irregular meals, and external stresses which make them more susceptible to illness and injury.

c. Disruption of basic hygiene and sanitation. Good personal hygiene and provision of sanitary food, water, and waste disposal become more challenging in the field. All personnel must know how to function under these conditions and discipline themselves to maintain high standards of hygiene and sanitation.

3. History is clear; environmental health and preventive medicine can make a difference. The outcome of a mission, conflict or war may depend on how well we reduce DNBI. By applying lessons learned from past experience, future problems can be prevented.

9-6. Medical Planning.

1. Medical planning is where good preventive medicine starts. PREVMED personnel must take the initiative to become actively involved in the pre-deployment planning phase of all unit deployments. Once operations begin, it is difficult, if not impossible, to alter plans set in the medical appendix to the operational plan (OPLAN). Involvement in the planning phase will enable

CAUSE ↓ / WARS →	WW II 1941–1945	KOREA 1950–1953	VIETNAM 1965–1970
DISEASE/ NONBATTLE INJURIES	**95.9%**	**82.4%**	**62.4%**
BATTLE INJURIES	4.1%	**17.6%**	**27.6%**

Table 9-1. Disease Nonbattle Injuries (DNBI) Matrix (Distribution of Casualties)

the PREVMED personnel to interact effectively with unit leaders, become knowledgeable about the operation/exercise and logistics, and to provide medical advice to prevent DNBI during the deployment. Specific predeployment activities should include as a minimum the following:

a. Compile preventive medicine information relevant to the area of operations (AO) and present it to the unit surgeon or commander along with recommendations for minimizing casualties due to preventable health threats.

b. Confer with other unit departments including engineering, intelligence (G-2/S-2), operations (G-3/S-3) and supply/logistics (G-4/S-4) to ensure adequate support for provisions, potable water, and availability of protective clothing and equipment, netting, repellent, and other necessities.

c. Provide preventive medicine briefs/training on expected health threats in the AO to deploying personnel.

d. Assist with health record reviews during predeployment medical preparation to ensure maximum readiness of unit personnel. Of particular interest to PREVMED personnel are the status of prophylactic immunizations and regimes, screening tests (PPDs, HIV, G6PD, sickle cell trait, etc.) and factors that would predispose any person to disease or injury.

2. *The Health Services Appendix to the Logistics/Combat Service Support Annex* of the OPLAN is the document which contains all the information necessary for providing health service support during the operation. The health services appendix has the following types of information:

a. Task organization of the medical service including attachments to specific combat units.

b. Specific missions for the next subordinate medical echelon and any broad missions which apply to the medical service as a whole.

c. Methods, supplies, and personnel to implement sanitation programs and information about health hazards peculiar to the operation or operating area, and precautions to minimize those hazards.

d. Plans for hospitalization and medical evacuation (MEDEVAC) of military personnel, prisoners of war, and displaced persons or civilians.

e. Amount of medical supplies to be carried by all units and medical supply distribution centers and details of medical resupply.

f. Information concerning augmentation, organization, and functions of Mobile Medical Augmentation Readiness Teams (MMARTs).

g. Methods, supplies, and personnel required to process casualties contaminated with chemical, biological, or radioactive substances. Special health hazards peculiar to handling contaminated casualties and precautions needed to minimize those hazards.

h. Procedures for obtaining medical information relevant to the AO.

3. Medical information or intelligence may be obtained from departments within the operating unit or from other commands prepared to provide such support. Marine Corps sources include G2/4, S2/4, the unit surgeon's office, and the medical battalion preventive medicine service (PMS). Sources of medical intelligence outside the Marine Corps are listed in Appendix A.

The Navy Disease Vector Ecology and Control Centers (NAVDISVECTECOLCONCENs) prepare in-depth Disease Vector Risk Assessment Profiles (VECTRAPS) and the Navy Environmental and Preventive Medicine Units (NAVENPVNTMEDUs) prepare Disease Risk Assessment Profiles (DISRAPS). These informative reports can be obtained by contacting the cognizant NAVDISVECTECOLCONCEN or NAVENPVNTMEDU for the AO.

4. A Preventive Medicine Journal is the key document in which all occurrences, actions and results are recorded. The journal is to be started by the PMT at the time of assignment to a unit. The journal format consists of two sections:

a. The opening page should identify points of contact for support units within the command structure.

b. The narrative summary section is as lengthy as is necessary and is intended for recording pertinent entries including daily' routines, meetings, problems reported to the PMT, assistance requests, conversations, visits, phone calls, and correspondence received or sent.

5. After Action Report (AAR): This report provides information to the CO about the course of events during the deployment and presents problems as they occurred. It also includes observations, recommendations, recognition of above-par or below-par areas, and conclusions. Comments should be focused or made on those conditions which had the most impact upon the operation. Suggestions on standardizing methods or avoiding problems in the next deployment should be included. The AAR should be submitted to the CO of the unit via the unit's Medical Officer. A copy should be sent to the cognizant NAVENPVNTMEDU. All journal entries and correspondence considered relevant to the report should be copied and included as enclosures. This will assist the next PMT deployed to the same AO during the pre-deployment phase.

a. The AAR should be separated into three phases:

(1) Predeployment
(2) Deployment
(3) Post-Deployment

b. Personnel deployed for less than 6 months must submit their AAR within 15 days of mission completion.

c. Personnel deployed for 6 months or more must submit their AAR within 30 days of mission completion.

9-7. Equipment and Supplies.

1. A complete inventory of equipment and supplies is essential for PREVMED personnel to carry out their mission in the field. It is important that the equipment and supplies be well stocked, maintained and ready for use in a moment's notice. Responsibilities for this equipment are given below:

a. The Force Service Support Group of the Marine Expeditionary Force (MEF) maintains Preventive Medicine and Vector Control Authorized Medical Allowance List (637/638 AMALs) for use in MEF size operations.

b. MMART AMALs are maintained by NAVENPVNTMEDUs and NAVDISVECTECOLCONCENs.

c. Equipment and supplies needed to support all other operations will be obtained at the local level and maintained by the cognizant PREVMED personnel in a "miniblock" configuration. Refer to local Preventive Medicine Departments or NAVENPVNTMEDUs for suggested equipment and supply needs specific to the AO.

2. PREVMED personnel must carry their own equipment and supplies on all operations. Do not expect Preventive Medicine Departments or units located in the vicinity of the deployment to have sufficient supplies and equipment to support your operation.

maintained by the cognizant PREVMED personnel in a "miniblock" configuration. Refer to local Preventive Medicine Departments or NAVENPVNTMEDUs for suggested equipment and supply needs specific to the AO.

2. PREVMED personnel must carry their own equipment and supplies on all operations. Do not expect Preventive Medicine Departments or units located in the vicinity of the deployment to have sufficient supplies and equipment to support your operation.

Section II. WATER SUPPLY SANITATION IN THE FIELD

9-8. Importance of Potable Water. Safe water, in sufficient quantities, is essential to every living organism. Insufficient quantity or quality of water is not only debilitating to the individual but will have a significant impact on unit operational readiness. Water which is not properly treated and disinfected can spread bacterial diseases such as cholera, shigellosis, typhoid, and paratyphoid fever. Untreated water can also transmit viral hepatitis, gastroenteritis and parasitic diseases such as amoebic dysentery, giardiasis and schistosomiasis.

9-9. Responsibilities.

1. Unit commanders are ultimately responsible to ensure there are sufficient quantities of safe water for their personnel. Commanders must take actions necessary to maintain an adequate supply of potable water. Such actions include properly treating raw water supplies to remove unacceptable levels of organic and inorganic substances and harmful microbes, and enforcing water discipline. Furthermore, commanders must ensure that their personnel are familiar with the dangers of consuming untreated water and know the proper methods for disinfecting their personal drinking water supplies if necessary.

2. Engineers are responsible for providing sufficient potable water for the population to be served. This includes selecting sources of raw water and construction, operation, and maintenance of all the structures and facilities used for collection, treatment, and distribution of potable water. The treatment process usually includes one or more of the following processes: coagulation, sedimentation, filtration, and disinfection. Although engineers will not normally deliver water to units in the field, they do establish, operate, and maintain water points where potable water is provided.

3. The medical department advises the commanding officer on water quality issues. This entails assisting the engineers in selecting water sources, surveying the potable water system, conducting routine bacteriological examination of the potable water supplies, testing the water for halogen levels and informing engineers of water quality and type of treatment required. The need for chemical analysis of field water supplies is made on a case by case basis by assigned medical and engineer personnel.

4. All personnel must be familiar with, and follow, proper water discipline. This includes consuming only water that has been properly treated and conserving and protecting the potable water supply. Every individual is responsible for ensuring that potable water does not become contaminated from careless or improper handling.

9-10. Sources of Water.

1. All water sources in the field should be considered unsafe until they have been evaluated and approved by the medical department.

2. Water maybe obtained from various sources in the field including rivers, streams, ponds, lakes, wells, ice, snow, oceans, etc. In choosing a raw water source, consider the following factors:

a. Quantity. Will the source provide an adequate supply of potable water for all hands for the expected length of stay? See paragraph 9-14 for computation of water requirements.

b. Quality

(1) Is the water free of significant contamination such as sewage, naturally occurring toxic elements or compounds or chemical, biological, or radiological (CBR) warfare agents?

(2) Is the water objectionable due to turbidity, color, odor, or taste?

(3) Is the water source protected from possible organic contamination by sewage fallout or runoff from latrines, showers, motor pools, etc.? Are there sources of inorganic contamination by mining wastes or runoff, etc.?

(4) Can the water be treated adequately with the resources available?

c. Accessibility. Is the source accessible to water purification and transport equipment?

3. Potential Sources of Water

a. Existing public water systems. These are the easiest and, in most cases, the safest sources because this water has been treated to some extent. This does not, however, preclude the necessity for evaluating the water and requiring additional treatment to make it safe.

b. Surface water. Surface water includes lakes, rivers, streams, and ponds. This source is usually more accessible than other sources and capable of supplying adequate quantities; however, water quality can be a problem. In lakes and ponds, place the intakes as far from shore as possible and neither too close to the bottom nor too near the surface to avoid picking Up mud and other debris. In rivers and streams, collect the water as far from known sources of contamination as possible.

c. Ground water. Ground water (wells and springs) is usually less contaminated than surface water. However, it is sometimes difficult to determine what quantities are available, The use of ground water by combat personnel is usually limited to existing wells and springs. Ground water sources must be located at least 100 feet from all existing sources of contamination and situated so that the drainage is away from the well or spring.

d. Salt water. When a salt water source is used the water must be desalinated and disinfected before it is consumed. Desalinization is usually accomplished with a reverse osmosis water purification unit (ROWPU) and the water is disinfected after desalinization.

e. Other sources. Rain, snow or ice may be used in circumstances when other sources are not available. This water will also require disinfection, particularly when large quantities are stored for later use. A more detailed discussion of water sources is presented in Chapter 5 of this manual.

9-11. Water Treatment.

1. Water treatment is the process of purifying water to make it potable. It may include one or all of the following processes:

a. Aeration, coagulation, flocculation (clarification), and filtration to remove suspended solids.

b. Reverse osmosis to remove suspended and dissolved matter including organic and inorganic contaminants.

c. Disinfection to eliminate microbial contaminants too small to be removed by filtration.

2. Equipment Used to Purify Water:

a. Two examples of equipment currently in use are:

(1) The ROWPU is the most common field purification system in use. This versatile unit will produce potable water from contaminated sources including fresh, brackish, or sea water. The finished water must be disinfected to eliminate viruses and protect the water from microbial contamination. Figure 9-1 illustrates a typical ROWPU setup. Figure 9–2 shows a basic water flow diagram through the various components of the ROWPU.

(2) The ERDLATOR is a transportable quick-response water purification system capable of aerating, clarifying, filtering and disinfecting contaminated water.

b. Routine inspection of units such as these should include checking the location of raw water intake and backwash filter waste. Ensure the intake is located away from sources of contamination and sediment and is upstream from waste water. Leaks, cross connections and other sources of contamination should be inspected for and guarded against. Engineering personnel use gauge readings to ensure the unit's components are operating properly. Medical personnel should familiarize themselves with normal readings for the type of unit in use. Table 9-2 lists normal and trouble point readings for the 600 Gallon per Hour ROWPU.

3. Disinfection. Disinfection destroys harmful organisms (pathogenic viruses, bacteria, and protozoans) present in the water by exposing them to specific concentrations of disinfecting agents or to heat. The basic procedures for disinfecting water are given below. These procedures may be modified in the field environment by the unit medical department to adapt to the local conditions or circumstances. Such factors as the quality of the water source, diseases endemic to the area of operation,

ROWPU FIELD SET-UP

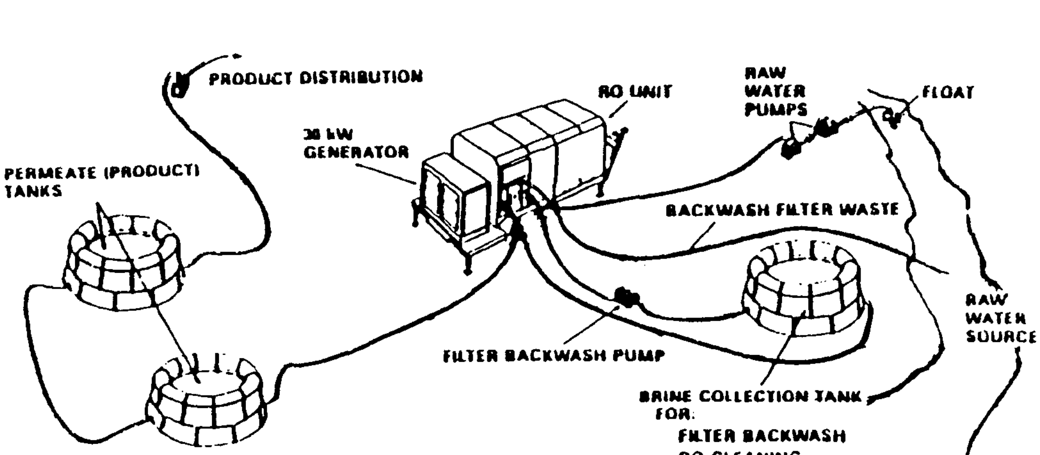
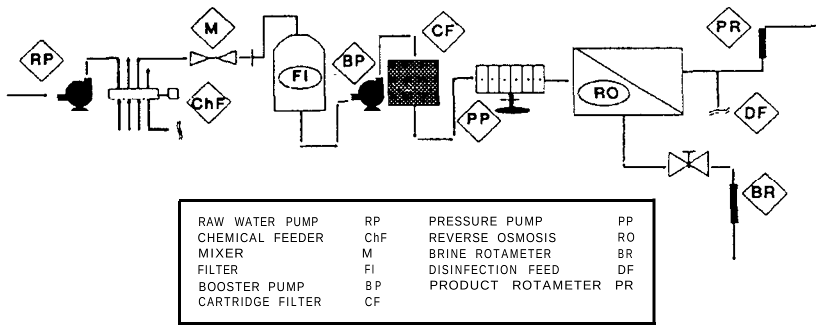


Figure 9–1.

600 GALLON PER HOUR ROWPU

BASIC FLOW SHEET



600 Gal/h ROWPU (leometric layout view)

Figure 9-2.

diseases experienced within the unit, and the integrity of the unit water system must be considered.

a. Chlorination. Chlorination is the most common method of disinfecting potable water. Sufficient chlorine is added to the water to achieve the desired free available chlorine (FAC) residual after a 30 minute contact time.

(1) Chlorine is available in several forms:

(a) Calcium hypochlorite, 65-70% (HTH). This is the preferred agent because it comes in granular form, has a long shelf-life and is readily available from the Navy stock system. It comes in convenient units including 100 lb drums, 3.75 lb containers, 6 oz bottles or 1 gm ampules.

(b) Sodium hypochlorite (5%) or (10%). This is a liquid solution (household bleach) and may be used in lieu of HTH. However, it is less convenient to handle, takes larger quantities to achieve the same concentration of FAC, and has a much shorter shelflife than HTH.

(c) Chlorine gas (in compressed gas cylinders). This is the most common form used by municipal

600 Gal/H ROWPU
GAUGE READINGS, NORMAL AND TROUBLE POINTS

INDICATOR GAUGE	NORMAL READING	TROUBLE POINT READING
1. Cartridge Filter	1 to 20 psid	Over 20 psid
2. Multimedia Filter	O to 10 psid	5 psid over first reading, or over 10 psid
3. Raw Water Flow	27 to 33 gpm	Drop to 25 gpm or less
4. Brine Flow	16 to 24 gpm	Below 15 gpm
5. Product Water Flow a. Salt Water b. Brackish water c. Fresh Water	 6 to 12 gpm Up to 13.5 gpm Up to 13.5 gpm	 Above 12.0 gpm Above 13.5 gpm Above 13.5 gpm
6. R. O. Pressure psi a. Salt Water b. Brackish Water c. Fresh Water	 800 psi or less 500 psi or less 500 psi or less	 Above 900 psi Above 600 psi Above 600 psi
7. R. O. Vessels	50 to 100 psid	Above 100 psid
8. TDS of Product Water	Below 1500 ppm	Above 1500 ppm

Table 9-2.

Chlorine Dosage Calculator

The figures on the following charts give the "dosage rate" for chlorination. The quality of water, e.g. the organic and inorganic materials present, will affect final chlorine residual. The amount of chlorine required to react with and be absorbed by these materials is called the "chlorine demand". The chlorine absorbed or neutralized has no disinfectant value, so it is necessary to add enough chlorine (adequate dosage rate) to satisfy the "chlorine demand" and still provide FAC. The FAC is the active disinfecting agent and is the chlorine reading determined with the calorimetric test kit.

For 5% Liquid Sodium Hypochlorite

Quantity (Gal) / PPM:	1	5	25	50	100	200
50,000	1 Gal.	5 Gal.	25 Gal.	50 Gal.	100 Gal.	200 Gal.
25,000	2 Qt.	10 Qt.	50 Qt.	25 Gal.	50 Gal.	100 Gal.
10,000	26 Oz.	1 Gal.	5 Gal.	10 Gal.	20 Gal.	40 Gal.
5,000	13 Oz.	2 Qt.	10 Qt.	5 Gal.	10 Gal.	20 Gal.
2,000	6 Oz.	26 Oz.	1 Gal.	2 Gal.	4 Gal.	6 Gal.
1,000	3 Oz.	13 oz.	2 Qt.	1 Gal.	2 Gal.	4 Gal.
500	2 Oz.	7 oz.	1 Qt.	2 Qt.	1 Gal.	2 Gal.
200	1 Tbsp.	3 Oz.	13 Oz.	26 Oz.	52 Oz.	103 Oz.
100	2 Tsp.	2 Oz.	7 Oz.	13 Oz.	26 Oz.	52 Oz.
50	1 Tsp.	1 Oz.	4 Oz.	7 Oz.	13 Oz.	26 Oz.
25		1 Tbsp.	2 Oz.	4 Oz.	7 Oz.	13 Oz.
10			1 Oz.	3 Tsp.	3 Oz.	6 Oz.
5			1 Tsp.	5 Tsp.	2 Oz.	3 Oz.

For 10% Liquid Sodium Hypochlorite

Quantity (Gal) / PPM:	1	5	25	50	100	200
50,000	2 Qt.	10 Qt.	50 Qt.	25 Gal.	50 Gal.	100 Gal.
25,000	1 Qt.	5 Qt.	25 Qt.	50 Qt.	25 Gal.	50 Gal.
10,000	13 oz.	2 Qt.	10 Qt.	5 Gal.	10 Gal.	20 Gal.
5,000	7 Oz.	1 Qt.	5 Qt.	10 Qt.	5 Gal.	10 Gal.
2,000	3 Oz.	13 Oz.	2 Qt.	1 Gal.	2 Gal.	4 Gal.
1,000	1.5 Oz.	7 Oz.	1 Qt.	2 Qt.	1 Gal.	2 Gal.
500	1 Oz.	4 Oz.	1 Pt.	1 Qt.	2 Qt.	1 Gal.
200	2 Tsp.	2 Oz.	7 Oz.	13 Oz.	26 Oz.	55 Oz.
100	1 Tsp.	1 Oz.	4 Oz.	7 Oz.	13 Oz.	26 Oz.
50		.5 Oz.	2 Oz.	4 Oz.	7 Oz.	13 Oz.
25		2 Tsp.	1 Oz.	2 Oz.	4 Oz.	7 Oz.
10		1 Tsp.			2 Oz.	3 Oz.
5					1 Oz.	2 Oz.

For 65 to 70% Granular Calcium Hypochlorite

Quantity (Gal) / PPM:	1	5	25	50	100	200
50,000	10 Oz.	3 lb.	15 lb.	30 lb.	59 lb. 9 Oz.	119 lb. 4 Oz.
25,000	5 Oz.	24 Oz.	7.5 lb.	15 lb.	29 lb. 12 Oz.	59.5 lb.
10,000	2 Oz.	10 Oz.	3 lb.	6 lb.	12 lb.	23 lb. 13 Oz.
5,000	1 Oz.	5 Oz.	1.5 lb.	3 lb.	6 lb.	11 lb. 15 Oz.
2,000		2 Oz.	10 Oz.	19 Oz.	2 lb. 7 Oz.	4 lb. 13 Oz.
1,000		1 Oz.	5 Oz.	10 Oz.	20 Oz.	2 lb. 7 Oz.
500			3 Oz.	5 Oz.	10 Oz.	19 Oz.
200			1 Oz.	2 Oz.	4 Oz.	8 Oz.
100				1 Oz.	2 Oz.	4 Oz.
50					1 Oz.	2 Oz.
25						1 Oz.

Table 9-3.

water treatment plants. However, chlorine gas is not normally considered appropriate for field use.

(2) Procedures for Chlorinating With HTH

(a) First make a small amount of HTH con. centrate by dissolving a measured amount of calcium hypochlorite granules (sufficient to produce the desired residual for the total volume of water to be disinfected) in a clean container (canteen cup, bucket, etc.) of water. Stir the mixture thoroughly. *Note that not all granules will dissolve.* Allow undissolved granules to settle to the bottom of the container. Only the clear liquid concentrate (supernatant) is added to the water to be disinfected. Refer to table 9–3 for the correct amount of HTH to add.

(b) Next, pour the supernatant into the water to be disinfected. Provide sufficient agitation to promote thorough mixing. This is best accomplished by adding the supernatant to the water container Oyster bag, trailer, tanker, etc.) when it is partially filled, then proceed to fill the container to the desired level with additional water.

(c) The final step is to take a measurement of the resulting FAC 30 minutes after adding the chlorine. The reading should be at or above the required dosage. If it is not, add additional chlorine and recheck the level after another 30 minutes. Repeat the procedure until the desired level is obtained.

(3) Required Chlorine Residuals:

Water Source	*Required Chlorine Residual*
1. Public water supply systems of questionable quality	5.0 parts per million (ppm) FAC after a 30 minute contact time and maintain at a minimum of 2.0 ppm FAC throughout distribution system.
2. Engineering water points	5.0 ppm FAC at the standpipe or fill-hose.
3. Water tankers, trailers, bladders and cans	Maintain between 5.0 ppm and 2.0 ppm FAC when filled at an approved engineering water point. Maintain at 5.0 ppm FAC when used as a "source" for a distribution (piping) system.
4. Distribution (piping) system	Maintain 5.0 ppm FAC at the source and 2.0 ppm FAC at the spigot.
5. Lyster bags and canteens	Maintain at 2.0 ppm FAC when filling from an approved water source. Chlorinate to 5.0 ppm FAC initially and maintain at 2.0 ppm FAC when filling from an unapproved or raw water source.

b. Superchlorination. This process is used to disinfect water containers and distribution systems initially (before they are used) or when they have become contaminated. Superchlorination is accomplished by chlorinating the water in a container or distribution system to at least 100 ppm FAC and holding it in the container for 4 hours. During that time the FAC must not drop below 50 ppm. Otherwise, the process must be repeated. The words "Poison Do Not Drink" must be displayed clearly on all sides of the container or at all water outlets during the process. The procedures are:

(1) Make up a supernatant of HTH as discussed previously. Use sufficient HTH to chlorinate the total volume of the water container or distribution system to at least 100 ppm (a higher concentration may be desirable, depending on the extent of the contamination in the container, to ensure the residual does not drop below 50 ppm after the 4 hour contact time). Refer to Table 9-3 for the amount of calcium hypochlorite granules or sodium hypochlorite bleach to use for the volume of the container or water pipes to be disinfected. Figure 9–3 provides a formula for estimating volume of water in a pipe for use in a distribution system.

(2) Add the supernatant to the partially filled container or distribution system and add additional water to fill the container or pipes.

(3) Determine the resulting FAC using a DPD kit. The water sample must be diluted 1:10 with distilled water to be within the range the DPD kit is

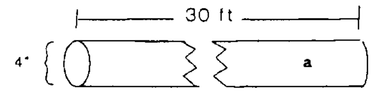
Formula for obtaining volume in different sized pipe

V = Gallons of fluid in a pipe

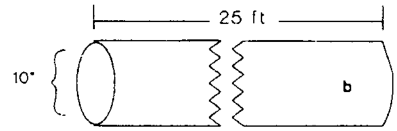
D = Diameter of pipe in inches

L = Length of pipe in feet

$V = D^2 \times .041 \times L$



a. $4^2 \times .041 \times 30$
$16 \times .041 \times 30$
$V_a = 19.68$ gal.



b. $10^2 \times .041 \times 25$
$100 \times .041 \times 25$
$V_b = 102.5$ gal

Figure 9-3.

designed to measure. Otherwise, the color quickly subsides or does not appear.

(4) Measure the FAC residual again after a 4 hour contact time. The FAC must be at least 50 ppm at this time. If the FAC is below 50 ppm the superchlorination procedure must be repeated.

(5) After superchlorination has been completed, drain the container or pipes, rinse them thoroughly and fill them with potable water from an approved source. In the event of scarce water supplies it maybe essential to use the superchlorinated water for drinking. If needed, the superchlorinated water may be dechlorinated with sodium thiosulfate or sodium bisulfite. However, large quantities of these agents may be required and the water must be dechlorinated as appropriate to protect the water from contamination.

c. Water Purification Tablets. Water purification tablets (NSN 6850–00-985–7166) are intended for disinfecting water contained in small containers such as canteens or water jugs. These tablets are usually composed of iodine and are available through the standard stock system in bottles of 50 tablets. These tablets are subject to deterioration in storage. Therefore, they must be inspected for signs of physical change before they are used. Otherwise, they may not disinfect the water! Iodine tablets which are completely yellow or brown or those which stick together or crumble easily are no longer effective and must be discarded or surveyed. Iodine tablets in good condition should be steel-gray in appearance. The procedures for disinfecting small quantities of water with these tablets are given below:

(1) Canteens

(a) Fill the canteen with the cleanest, clearest water available.

(b) Add two (2) iodine tablets to each canteen full of any type of water. Double these amounts for 2 quart canteens. Tincture of iodine 2% may be used in place of the tablets. Put 5 drops per 1 quart canteen of clean water or 10 drops if the water is cloudy.

(c) Place the cap on the canteen loosely. Wait 5 minutes, then shake the canteen vigorously, allowing leakage to rinse the threads around the neck of the canteen.

(d) Tighten the cap and wait an additional 30 minutes before using the water for any purpose.

(2) Five Gallon Cans

(a) Fill a 5 gallon container with the cleanest, clearest water available.

(b) Dissolve 40 iodine tablets in a canteen cup full of water to disinfect any type of water. Add this solution to the 5 gallon container of water and agitate the solution.

(c) Place the cap on the container loosely. Wait 5 minutes, then agitate the container vigorously, allowing leakage to rinse the threads around the neck of the can.

(d) Tighten the cap and wait an additional 30 minutes before using the water for any purpose.

d. Boiling. Boiling is a simple, effective method of disinfecting nonpotable water. Use the cleanest water available and bring it to a rolling boil for 2 minutes; then let it cool. This method is only practical for small containers of water such as canteens and it has several disadvantages:

(1) Fuel is required.

(2) It is time consuming. It takes a long time for the water to boil and then to cool.

(3) There is no residual substance in the water to guard against contamination.

9-12. Water Containers. The water standards discussed below apply to canteens, water jugs, lyster bags, bladders, trailers, tankers, water mains, hoses, piping systems and other vessels used to hold or convey potable water:

1. All containers used for the treatment, storage or distribution of water must be clean and clearly labeled "Potable Water. "

2. Interior surfaces must be constructed of smooth, nontoxic, noncorrosive materials and free from rust and chips. They must have tight fitting caps or lids which close securely. The gaskets must be easily cleanable.

3. Potable water containers must not be used for any other purpose and must be inspected, cleaned, and disinfected whenever necessary but not less than monthly.

9-13. Disinfection of Water Containers and Systems.

1. Mechanical cleaning and chemical disinfection must be accomplished when one or more of the following conditions exists:

a. Prior to placing a new container or system into service.

b. Prior to using containers or systems that have an accumulation of rust, scale, or sludge.

c. When there is evidence of contamination (human, animal, or chemical).

d. In extreme water emergencies, fuel oil containers can be converted for potable water use. In this event, special attention must be given in removing all fuel oil residues from these containers before disinfection and use. Containers whose contact surfaces are not readily accessible for inspection and cleaning (e.g., 5 gallon gas cans) must never be used for the storage of potable water. Also fuel oil hoses must never be used for potable water because of possible chemical reactions between the fuel and the rubber compounds within the hose.

e. Whenever system components have been dismantled or replaced for the purpose of repair or alteration.

2. Mechanical Cleaning Procedures

a. Drain the container or system.

b. Scrub the interior surfaces with a soft brush and a detergent solution taking care not to damage the interior lining. Be sure to scrub all gaskets, lids, and spigot openings.

c. High pressure water or steam should be used, if available, to rinse the container.

d. Open all valves, lids, taps, or spigots and allow the detergent solution to drain out through the system.

e. Rinse all surfaces thoroughly with potable water. Several rinsings may be necessary.

f. Superchlorinate the container or system as described in Article 9–11.3.b.

9-14. Water Quantity Requirements. Ensuring that personnel consume sufficient quantities of water is extremely important. This keeps them in good physical and mental condition to complete their mission. The daily water requirements for personnel in the field varies with a number of factors including the season of the year, geographical area, and the tactical situation. Dehydration can occur quickly in both extremely hot or cold climates if personnel don't drink plenty of water. Personnel in extreme environments must drink water even if they don't "feel thirsty." The minimum water consumption requirements under arid conditions to prevent dehydration is provided in Table 9-4. Slightly less water is required in temperate zones. A method for computing water requirements is provided in Table 9–5. A rule of thumb for the minimum amount of water required for advanced base medical facilities is 65 gallons per medical treatment bed per day.

9-15. Testing Requirements.

1. FAC Testing

a. Determine the FAC residual of all water supplies at least daily. Tests should be performed on all engineering water points, tankers, trailers, bladders, lyster bags, and on representative samples from 5 gallon cans and distribution system spigots. In the latter instance, the sampling points must be varied from day to day and be representative of the entire lot of cans or the distribution system.

b. Record the results in the Medical Department Water Log and investigate the cause of any low readings. Report all significant findings to the unit engineer. Prompt action must be taken by the unit engineer to

DAILY WATER REQUIREMENTS
Multi-Service Water Consumption
for Arid Environment[a]

1. USAGE FACTORS	GAL/MAN/DAY	
	Marines	Navy
Drinking[b]	5.2	5.2
Hygiene [b] (Brushing teeth, shaving)	2.7	2.7
Centralized showers[b]	1.3	1.3
Food Preparation[b]	3.0	3.0
Vehicles	0.3	0.3
Medical[b]:		
Heat treatment (ice water)	1.0	1.0
Hospitals	65 gal/bed/day)	
Graves registration (50 gal/KIA)[c]	0.2	0.2
Laundry (6 lb/man/wk)	2.0	2.0
Construction [d]	1.5	1.5
Aircraft	0.7	5.2
Total Use	17.9	22.4
Waste/evaporation (10% of total)	1.8	2.2
Total	19.7	24.6

Notes:

a. For light work and normal salt intake.

b. Must be potable. All other water quality must be consistent with intended use,

c. Army accomplishes graves registration for all services within the theater of operations. (KIA = killed in action)

d. Dust control must be accomplished by means other than water.

2. Recommended Joint Planning Factor: 20 gal/man/day (Includes waste/evaporation factor but excludes requirements for decontamination, POWs, refugees, and civilians).

3. Decontamination requirements: Cannot be reduced to gal/man/day factor. The following can be used for planning purposes:

a. Combat troop-13 gal per decontamination application. (This need not be potable water.)

b. Major end items—200 gal per decontamination application. In addition, the following should be considered:

(1) Factors apply each time a person or piece of equipment requires decontamination due to the presence of persistent chemical agent.

(2) The factors assume that the contaminated units will apply sound decontamination principles.

(3) All personnel and equipment in a given unit are assumed to require decontamination if any one person or piece of equipment becomes contaminated.

(4) For many pieces of equipment, specific decontamination procedures and times have not been established, especially for aircraft, generators, communications gear, and crew-served weapons.

Table 9-4.

eliminate all sources of contamination or other factors contributing to the FAC dissipation and to restore the FAC to the appropriate levels addressed in Article 9-11.3.a.(3).

2. Bacteriological Testing

a. Field water supplies must be tested bacteriologically at least weekly following the procedures provided in Chapter 6 of this manual. Analysis must be accomplished on all engineering water points, tankers, trailers, bladders and lyster bags and representative samples of 5 gallon cans and distribution system spigots. Sample points must be varied to represent the entire lot of cans or the distribution system.

b. Record the results in the Medical Department Water Log.

c. Notify the unit commander of all positive results which indicated possible contamination and recommend that the container(s) or sampling point(s) in question be secured until disinfection and retesting can be performed.

d. Investigate to determine the source(s) of contamination and retest. The positive sampling point(s) container (s) or spigot (s) must remain secured until

SAMPLE METHODOLOGY FOR COMPUTING UNIT/FORCE WATER REQUIREMENT

1. Company (160 men)	
Drink + P. Hyg + Food + Veh = Unit Factor	(5.2 + 2.7 + 3.0 + 0.3 = 11.2 G/M/D
Unit Factor x Unit Str. = Co. Consumption	(11.2 x 160 = 1792 gal/day)
Consumption + 10% Waste = Co. Requirement	(1792 + 179 = 1971 gal/day)
2. Battalion (750 men)	
Unit Factor + Heat Treat = Bn Factor	(11.2 + 1.0 = 12.2)
Bn Factor x Bn Str = Consumption	(12.2 x 750 = 9150)
Consumption + 10% Waste = Hn Requirement	(9150 + 915 = 10,065 gal/day)
3. Brigade (3500 men)	
Bn Factor + Cent. Hyg = Bde Factor	(12.2 + 1.3 = 13.5)
Bde Factor x Bde Str = Bde Consumption	(13.5 x 3500 = 47,250)
Consumption + 10% Waste = Bde Requirement	(47,250 + 4725 = 51,975)
4. Division (16,000 men)	
Bde Factor + Hosp + Ldry + Grav + Constr = Div Factor	(13.5 + 1.0 + 2.0 + 0.2 + 1.5 = 18.2)
Div Factor x Div Str = Div Consumption	(18.2 x 16,000 = 291,200)
Consumption + 10% Waste = Div Requirement	(291,200 + 29,120 = 320,320)
5. Corps/Force (____ men)	
Navy Service Factor × Non self-sustaining Str = Reqt	(24.4. × ____ = (N))
USMC Service Factor × Non self-sustaining Str = Reqt	(19.5 × ____ = (MC))
Army Service Factor (incl. waste) × Army Str = Reqt	(17.2 × ____ = (A))
USAF Service Factor × Non self-sustaining Str = Reqt	(21.5 × ____ = (AF))

N + MC + A + AF = Total Requirement for Force Support

Note: 1. Non self-sustaining strength = Number of personnel to support
2. Service Factor is outlined in Table 9-4

Table 9-5.

negative follow-up samples are obtained. Retesting requires 300 milliters of water be tested for each 100 ml original positive sample. Follow-up testing is accomplished as follows.

(1) In a distribution system, take a 100 ml follow-up sample from the original positive spigot, take one from within 5 outlets upstream of the original positive sample and one from within 5 outlets downstream. If the original positive sample was at the end of the distribution line, two samples will be collected downstream (within 5 outlets) from the original positive sampling site.

(2) Distribution systems with a single outlet, tankers, trailers, bladders, Lyster bags and 5 gallon cans will have three 100 ml samples taken from the original positive sampling site. When testing the three 100 ml samples from a single testing site, using the membrane filter technique, it is optional to filter each 100 ml through a single filter or the three 100 ml samples (300 ml) may be filtered through a single filter.

e. The water is considered safe to use when the set of follow-up samples are total coliform negative.

SAMPLE METHODOLOGY FOR COMPUTING UNIT/FORCE WATER REQUIREMENT

1. Company (160 men)	
Drink + P. Hyg + Food + Veh = Unit Factor	(5.2 + 2.7 + 3.0 + 0.3 = 11.2 G/M/D
Unit Factor x Unit Str. = Co. Consumption	(11.2 x 160 = 1792 gal/day)
Consumption + 10% Waste = Co. Requirement	(1792 + 179 = 1971 gal/day)
2. Battalion (750 men)	
Unit Factor + Heat Treat = Bn Factor	(11.2 + 1.0 = 12.2)
Bn Factor x Bn Str = Consumption	(12.2 x 750 = 9150)
Consumption + 10% Waste = Hn Requirement	(9150 + 915 = 10,065 gal/day)
3. Brigade (3500 men)	
Bn Factor + Cent. Hyg = Bde Factor	(12.2 + 1.3 = 13.5)
Bde Factor x Bde Str = Bde Consumption	(13.5 x 3500 = 47,250)
Consumption + 10% Waste = Bde Requirement	(47,250 + 4725 = 51,975)
4. Division (16,000 men)	
Bde Factor + Hosp + Ldry + Grav + Constr = Div Factor	(13.5 + 1.0 + 2.0 + 0.2 + 1.5 = 18.2)
Div Factor x Div Str = Div Consumption	(18.2 x 16,000 = 291,200)
Consumption + 10% Waste = Div Requirement	(291,200 + 29,120 = 320,320)
5. Corps/Force (____ men)	
Navy Service Factor × Non self-sustaining Str = Reqt	(24.4. × ______ = (N))
USMC Service Factor × Non self-sustaining Str = Reqt	(19.5 × ______ = (MC))
Army Service Factor (incl. waste) × Army Str = Reqt	(17.2 × ______ = (A))
USAF Service Factor × Non self-sustaining Str = Reqt	(21.5 × ______ = (AF))

N + MC + A + AF = Total Requirement for Force Support

Note: 1. Non self-sustaining strength = Number of personnel to support
2. Service Factor is outlined in Table 9-4

Table 9-5.

negative follow-up samples are obtained. Retesting requires 300 milliters of water be tested for each 100 ml original positive sample. Follow-up testing is accomplished as follows.

(1) In a distribution system, take a 100 ml follow-up sample from the original positive spigot, take one from within 5 outlets upstream of the original positive sample and one from within 5 outlets downstream. If the original positive sample was at the end of the distribution line, two samples will be collected downstream (within 5 outlets) from the original positive sampling site.

(2) Distribution systems with a single outlet, tankers, trailers, bladders, Lyster bags and 5 gallon cans will have three 100 ml samples taken from the original positive sampling site. When testing the three 100 ml samples from a single testing site, using the membrane filter technique, it is optional to filter each 100 ml through a single filter or the three 100 ml samples (300 ml) may be filtered through a single filter.

e. The water is considered safe to use when the set of follow-up samples are total coliform negative.

Section III. FOOD SERVICE IN THE FIELD

Article

9-16. Importance of Sanitary Practices in the Handling of Food.

1. The conditions under which food is transported, stored, prepared, and served can have a direct bearing on the success or failure of a military mission. Consumption of food contaminated with disease causing microorganisms can result in outbreaks of foodborne illness and compromise the combat readiness of the unit. All personnel who handle food must maintain the highest stan-

dards of personal hygiene and sanitary practices.

2. In the field, all the factors which normally contribute to foodborne illness outbreaks, such as improper storage and holding temperatures, inadequate protection of food from contamination, and poor food handler personal hygiene, are exacerbated. Supervisory responsibilities and individual attention to sound sanitary practices become increasingly important. Whenever possible, food service sanitation regulations set forth in Chapter 1 of this manual will be followed.

9-17. Transportation of Food.

1. Vehicles used for transporting food must be clean and completely enclosed, if possible. Clean tarpaulins, boxes, bags, etc., may be used to protect food from contamination by dust, dirt, and the elements.

2. Vehicles used for transporting garbage, trash, chemicals, petroleum products, or similar materials will not be used for transporting food unless they have been properly cleaned and sanitized.

3. If bulk quantities of perishable foods are to be transported over considerable distances, refrigerated containers must be used.

4. Perishable food products must be stocked at a level commensurate with the capacity of the food service storage facilities of the unit.

9-18. Storage.

1. All food items are to be inspected by the food service officer (FSO), or his designated representative, at the time of receipt. These inspections are usually limited to identity, count, and condition. If the fitness of any item appears questionable or the food item has been purchased on the local market or under contracts which require inspection at destination, the FSO must request an inspection of the item from the MDR. Accepted food items will be stored immediately. Unaccepted items will be disposed of in accordance with Chapter 1 of this manual. Otherwise, any food determined unfit for human consumption by the MDR will be surveyed as garbage.

2. Field refrigerators and freezers are available for use but internal space is limited. Temperature controls may not always be accurate and exposure to the elements puts a tremendous strain on the working parts. Creating a shade and dust barrier can improve these conditions tremendously. Careful monitoring of internal temperatures and maintenance of temperature logs are mandatory. One internal and one external thermometer is required on all bulk storage refrigerators/freezers. An external, high temperature alarm system is strongly recommended. Temperature readings must be taken and logged at least once per meal period (at least 3 times each day). Resupply of spoiled rations may take several days; therefore, reading and logging of cold storage temperatures every three hours is recommended. Care must be given to menu planning to help ease refrigerated space requirements.

3. Refrigerated space should be emptied and thoroughly cleaned at least once per week. These spaces must be defrosted whenever the frost accumulation on the cooling coils exceeds ¼ of an inch thick.

4. Perishable foods must be refrigerated or frozen at temperatures noted in Chapter 1 of this manual. As a general rule, field reefers will be maintained at or below 40 degrees Fahrenheit (F). Freezers will be maintained at or below O degrees F.

5. Semi-perishable foods such as potatoes, onions, lettuce, etc., must be stored in a dry place on dunnage/ pallets to allow for air circulation and to protect them from decay, spoilage, and vermin infestation. Screened food boxes may be used to keep such items as bread for short periods of time. These screened boxes can be suspended to permit free circulation of air.

6. Nonperishable/canned foods, such as canned vegetables, dried beans, flour, sugar, etc., must be palletized to allow for air circulation and minimize harborage for vermin. These items also need protection from the elements. Improper storage will result in the loss/ destruction of the product. The contents of any can showing signs of deterioration will be disposed of as garbage.

7. All storage spaces should be inspected regularly for evidence of vermin infestation.

9-19. Preparation and Serving.

1. As in garrison, messmen working in a field galley must receive food handlers' physicals as specified in Chapter 1 of this manual. Due to the many problems associated with field exercises and special problems with sanitation, screening of food handlers is very important. Freedom from disease, acne, cuts/scratches, and a high level of personal hygiene is essential. Food service physicals will be given prior to deployment. This will also afford an opportunity to establish contact with and ensure proper training of mess supervisory personnel. Handwashing stations for mess men and cooks must be readily available with soap and water, figures 9-4 and 9-5.

2. Foods will be handled in accordance with Chapter 1 and the following:

a. Potentially hazardous foods should be avoided in a field situation. The lack of clean preparation areas, inadequate spaces for refrigeration, unreliable electrical supplies, and the potential for contamination dramatically increases the potential for a foodborne illness outbreak. Improperly handled potentially hazardous food items must be discarded as garbage.

b. Chopping and grinding of meat in the field is prohibited. When meats need to be pre-sliced, they will be carefully protected and refrigerated or cooked immediately.

c. Frozen foods should be thawed under refrigeration. Foods may be thawed at room temperature when no refrigeration space is available. The following conditions must be met when thawing at room temperature:

(1) The product must be cooked as soon as possible once thawed.

(2) The room temperature must not exceed 80° degrees Fahrenheit (26.7° C).

(3) Meat, poultry and fish must remain in their original sealed wrappers or containers.

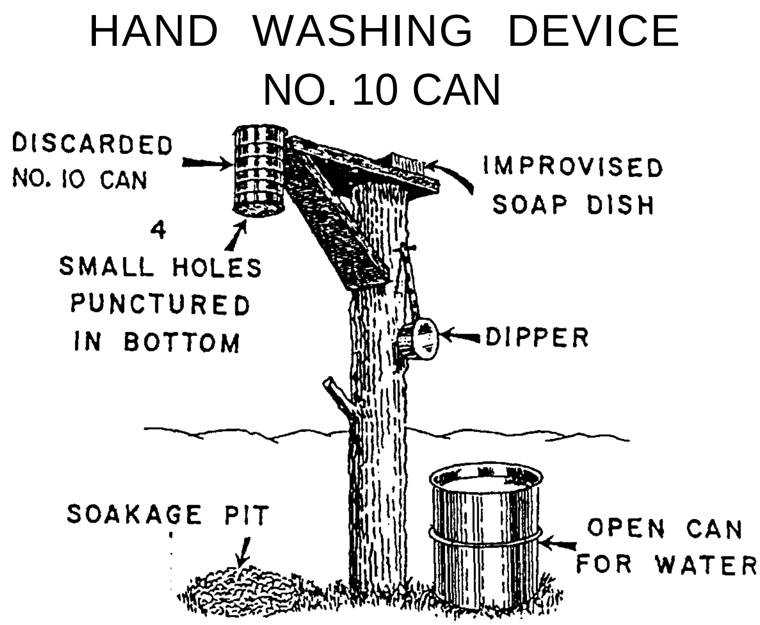


Figure 9-4.

A hand washing facility which is suitable for installation near latrines and messes is easily improvised using a perforated number 10 can sprinkler, small can dipper and open oil drum as a clear water reservoir. The soap dish may be fabricated using a small can which has been split and sharp edges turned down.

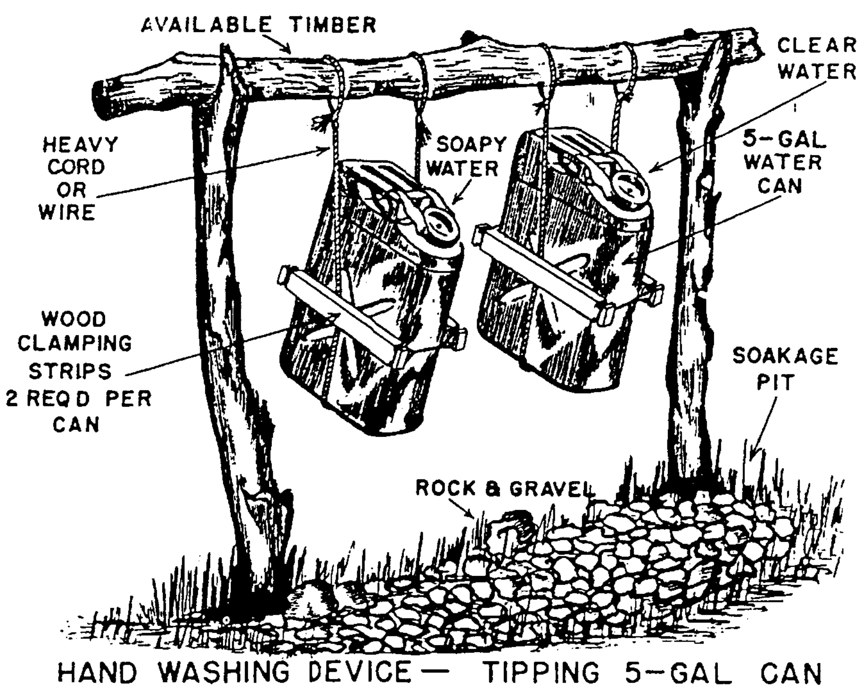


Figure 9-5.

A hand washing facility which is suitable for installation near latrines or messes is easily improvised using 5-gallon water cans. The cap of the cans may be perforated with ¼ inch holes to conserve washing water.

(4) Proper precautions are taken to ensure potentially hazardous foods are not allowed to remain at room temperature once thawed.

(5) The Medical department representative is notified.

(6) Thawed foods must never be refrozen.

d. Serving lines in field messes usually are unable to maintain proper holding temperatures and refrigerated space is at a premium. Therefore, due to the" increased potential for food contamination in the field mess, the saving of leftovers is strictly prohibited. All leftovers must be disposed of as garbage.

e. Ice machines at field messes are to be scrupulously maintained. These units must not be operated as self service types of equipment. Use an ice scoop made of impervious material. Store the scoop in a metal bracket inside the ice storage bin. Mount the bracket at a level at which the scoop will not be covered with ice when the bin is full. The scoops are to be properly washed and sanitized at least daily. The use of ice chests by individuals or groups will be discouraged. Bacteriological testing requirements are discussed in Chapters 1 and 6 of this manual.

f. Sandwiches should be prepared as close as possible to serving time. Condiments such as mayonnaise, relish, etc., will be provided in individual packets only and applied by the patron. Salad type fillings, such as egg, tuna and poultry, are prohibited.

g. Care must be exercised with fruits and vegetables obtained from the local economy, particularly in areas where “night soil” is used as a fertilizer. These products must be soaked in a 100 ppm FAC solution for 15 minutes or a 50 ppm FAC solution for 30 minutes and thoroughly rinsed with potable water before serving.

h. Self-service areas are authorized for prepackaged items such as individual cartons of milk, salt, pepper, syrup, catsup, mustard, and mayonnaise. Individual cartons of milk must be displayed in drainable trays containing ice. Ensure the top portion of the carton is not submersed in the ice.

i. All food, except self-service items, must be served by a physically qualified and properly trained cook or messman.

j. When items requiring refrigeration are placed on the serving line, they must be placed on the line in small quantities and replenished as needed.

k. Foods requiring hydration, such as powdered eggs, must be handled as fresh food items once they are hydrated.

3. The “Four Hour Time Rule” must be strictly enforced in the field. Potentially hazardous foods, which have been held at temperatures between 40 degrees F. and 140 degrees F. for more than four hours cumulative time must be disposed of as garbage. Remember to keep hot foods hot (140 degrees F. or above) and cold foods cold, 40 degrees F. or below.

9-20. Mess Facilities and Equipment.

1. Advance base/field messes range from primitive (i.e., where personnel sit on the ground to eat after receiving their rations, cooking accomplished in a tent) to a semipermanent structure with plumbed in water, concrete decks and portable galley equipment. Some of these field messes have stainless steel surfaces for food preparation, whereas only wooden surfaces may be available in others. Regardless of the type of structure, cleanliness will be the key to the prevention of foodborne illness outbreaks. The following provides general guidance and should be used in conjunction with chapter 1 of this manual:

a. Vat cans, ovens, stoves, grills, and other food preparation and serving equipment must be thoroughly cleaned and sanitized after each meal period.

b. All needed repairs must be made as soon as practicable.

c. All food contact surfaces must be cleaned and sanitized as described in Chapter 1 of this manual.

d. All food service equipment is to be installed up off the ground and protected from contamination by dust and vermin.

e. Wooden surfaces should be covered with clean, heavy wrapping paper or waxed paper. Discard the paper after each meal period. If paper is not available, surfaces must be wiped down and scrubbed with an approved sanitizing solution and air dried after each meal period.

f. When pesticides are used, the directions on the label are to be strictly adhered to. Use caution when applying pesticides in the food service areas. All food and food contact surfaces are to be properly protected during spraying and dusting operations. Pesticides are not to be stored in a food service area at any time. Pesticides are to be applied only by certified personnel. Chapter 8 of this manual gives detailed information on pesticide application and pest control programs.

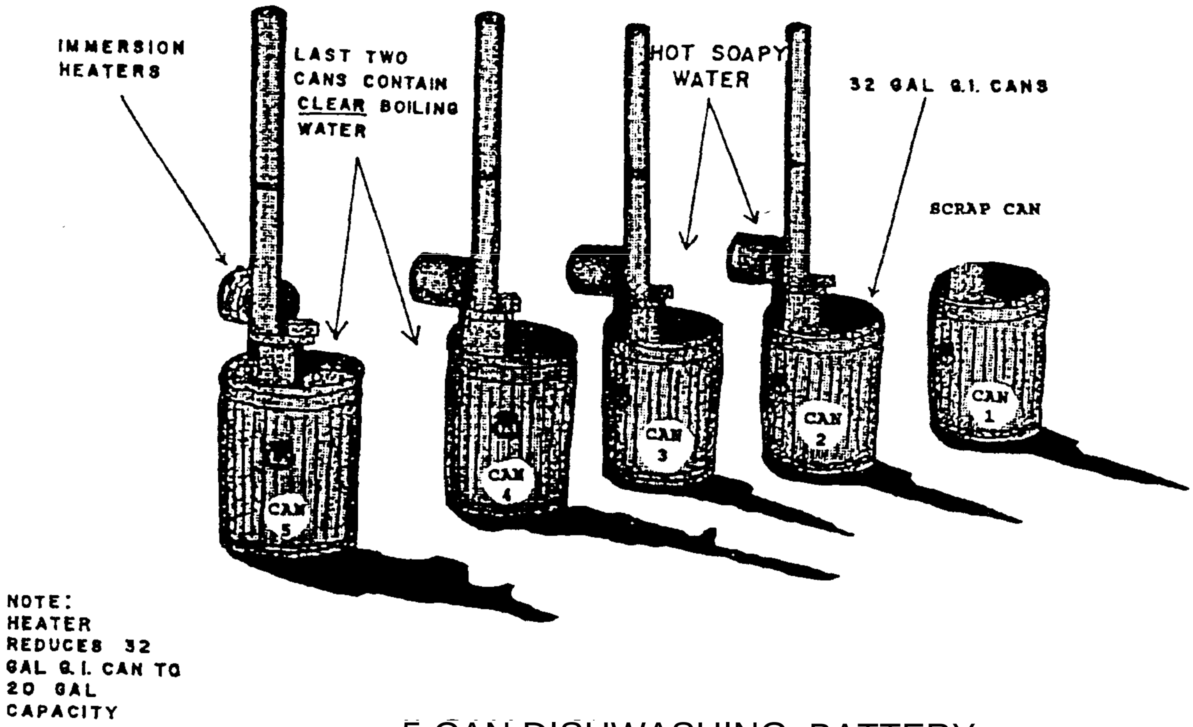
g. The use of disposable eating utensils is encouraged. The benefits of reduced disease risk, and water/fuel savings outweigh the solid waste disposal disadvantage.

2. Insulated food containers (vat cans) are used to transport, store, and serve hot or cold foods. Each container has three aluminum inserts and a tight fitting cover. Inserts must always be used and are to be filled to capacity ($5\frac{1}{3}$ liters/$5\frac{2}{3}$ quarts). Inserts of hot food and inserts of cold food must be placed in separate containers.

a. Preparation, filling, pre-heating and prechilling of the container must be accomplished prior to placing inserts with food into the container. This is accomplished by filling the container with 2 quarts of boiling water, ice water, or crushed ice, covering the container, and letting it stand for 30 minutes before use. After filling, each container must be labeled across the top of the container lid with the item, date and time of preparation, and number of servings. Foods held for over four hours must be discarded as garbage.

b. Cleaning of vat cans is critical and should be performed before and after every use. Vat cans should not be immersed in water. Inserts and rubber gaskets must be removed and washed with soap and water then rinsed in boiling water. After gaskets have been washed and rinsed, they should be placed flat side down on the container to dry to prevent warping.

3. A field dishwashing unit can be set up by using five (5) metal GI cans (approximately 32 gallon size) and



5 CAN DISHWASHING BATTERY

Figure 9-6.

immersion heaters. A long handled brush is to be attached to wash cans number two and three. To avoid burns, hooks made from coat hangers can be used for clipping metal trays in the fourth and fifth cans.

a. The dishwashing battery, as illustrated in figure 9-6, is set up in the following manner:

(1) First GI can is for collecting garbage.

(2) Second GI can is for prewash and will contain a hot detergent solution and a brush.

(3) Third GI can is for washing and will contain a hot detergent solution and a brush.

(4) Fourth GI can is for rinsing and will contain clean hot water held at a rolling boil.

(5) Fifth can is for the final sanitizing rinse and will contain clean hot water held at a rolling boil.

(6) Mess gear will be air dried only. No dish cloths are permitted.

(7) The water in the cans must be changed as often as necessary to ensure proper cleaning.

(8) Each can must be permanently marked as to its use (e.g., garbage, prewash). These cans must never be used for any other purpose.

(9) A similar unit can be set up for pots and pans using one can for wash, one can for rinse and one can for sanitizing rinse. Dip and drain racks or a suitable alternative will have to be devised to prevent hands from contacting boiling water.

b. The field dishwashing area must be away from the food preparation and serving area so that carbon monoxide, smoke, and soot do not blow back into the food service areas. Immersion heaters also present an explosion hazard.

3. In emergency situations where hot water is not available, messing utensils can be sanitized by immersion in a 50 ppm FAC solution for 60 seconds.

4. The entire food service area will have proper drainage to eliminate or prevent standing water.

9-21. Galley Waste Disposal.

1. Soakage pits.

a. Soakage pits must be constructed to dispose of waste water from the food service area. Special attention is to be given to the separation of grease and scrap food particles from the waste water. Grease must be contained and not allowed to enter drainage ditches, evaporating beds, leaching fields, or soakage pits as grease will clog the soil, preventing the absorption of the water. It will also attract vermin, provide a breeding site for flies, and give off offensive odors. Diagrams of soakage pits and trenches and grease traps are found in article 9-27 of this chapter.

b. Determine the required soakage pit size (volume) by considering these factors: duration of the operation, number of personnel involved, amount of drainage generated per day, expected period of use, and absorbent quality of the soil substrate.

2. Collect and properly dispose of solid wastes such as garbage, metal cans, plastic, and cardboard. Methods of

disposal consist of compacting, burial or burning and in many cases local contractor recycling. In peacetime, local civilian health authorities must be consulted prior to selecting a disposal method. The method to be employed may vary from area to area depending on environmental and tactical situations. Solid wastes are not to be buried or burned in close proximity to the galley or messing areas.

3. The proper disposal of liquid and solid wastes will greatly enhance pest control operations in any given area. Further waste disposal guidance is contained in section IV of this chapter.

9-22. Meal, Ready to Eat (MRE).

1. The MRE was designed as the replacement item for the more familiar Combat Rations or C Rations. They are lighter, less bulky, and easier for personnel to transport. There are several different menus available.

2. The MRE presently has a shelf life of 48 months. Routine inspection schedules must be established to ensure adequate stock rotation and suitability for use of the product. There are no special storage requirements established for the MRE's. However, they must be stored off the deck and not stacked more than three pallets high without the use of storage aids. Inspect the MRE's by taking a random sample of the oldest stock. Use a square (approximately 36" x 36") of smooth white paper for a surface on which to inspect case contents. Remove sleeve from the MRE case. Open the case and invert it, dumping the MRE's onto the paper. Rap case sharply to knock out any insects or debris onto paper. Collect insect specimens for identification. Inspect MRE menu bags individually. Check menu bag for punctures caused by spoons packed within each bag. Check for miscellaneous penetrations caused by knives, staples, etc. Inspect the folds and seams of the bag for insect debris and penetration. Most insect penetrations will be found along folds and seams. Note: The menu bag is the outer bag containing a list of the components within the MRE.

3. MREs are subject to infestation by boring/chewing insects such as *Rhyzopertha dominica* (lesser grain borer), *Trogoderma variabile* (warehouse beetle), *Lasioderma serricorne* (cigarette beetle), *Tribolium castaneum* (red flour beetle), and *Tribolium confusum* (confused flour beetle). This infestation would most likely occur in MRE cases that are stored for long periods of time and/or those located in the least lighted area of the storerooms or warehouses. Once the integrity of the outer or menu bag has been breached, any small insect can invade the bag. Components are rarely penetrated, however, the insects may explore a poor seal in a component package. Most susceptible components are peanut butter and cocoa beverage powder.

4. The practice of heating entrees in a container of hot water and then using the water for hydration of food or drink is to be discouraged. This is due to the possibility of laminates leaching into the water.

9-23. T-Rations.

1. Tray packs are the main component of T-Rations. They are semi-perishable food items which provide nutritionally adequate hot meals while reducing the manpower, fuel and water requirements for feeding. The tray packs are hermetically-sealed half-size steam table containers in which up to 36 servings of food, depending on product, have been thermally processed and can be transported and stored without refrigeration. Contents can be easily heated in and served directly from the tray packs.

2. The tray pack serves as a storage, heating, and serving vessel. They are heated by immersion in boiling water from 15 to 45 minutes. During heating, some swelling of cans is expected. Overheating (especially vegetable products) causes excessive swelling. If tray packs become extremely cold or frozen from arctic conditions, heating time will have to be adjusted. Frozen tray packs may show degradation of texture when prepared.

3. After initial heating, *unopened* tray packs may be retained for re-use under the following conditions:

a. They must be marked with the time and date of initial heating.

b. They must be used at the *next* meal period or discarded.

disposal consist of compacting, burial or burning and in many cases local contractor recycling. In peacetime, local civilian health authorities must be consulted prior to selecting a disposal method. The method to be employed may vary from area to area depending on environmental and tactical situations. Solid wastes are not to be buried or burned in close proximity to the galley or messing areas.

3. The proper disposal of liquid and solid wastes will greatly enhance pest control operations in any given area. Further waste disposal guidance is contained in section IV of this chapter.

9-22. Meal, Ready to Eat (MRE).

1. The MRE was designed as the replacement item for the more familiar Combat Rations or C Rations. They are lighter, less bulky, and easier for personnel to transport. There are several different menus available.

2. The MRE presently has a shelf life of 48 months. Routine inspection schedules must be established to ensure adequate stock rotation and suitability for use of the product. There are no special storage requirements established for the MRE's. However, they must be stored off the deck and not stacked more than three pallets high without the use of storage aids. Inspect the MRE's by taking a random sample of the oldest stock. Use a square (approximately 36" x 36") of smooth white paper for a surface on which to inspect case contents. Remove sleeve from the MRE case. Open the case and invert it, dumping the MRE's onto the paper. Rap case sharply to knock out any insects or debris onto paper. Collect insect specimens for identification. Inspect MRE menu bags individually. Check menu bag for punctures caused by spoons packed within each bag. Check for miscellaneous penetrations caused by knives, staples, etc. Inspect the folds and seams of the bag for insect debris and penetration. Most insect penetrations will be found along folds and seams. Note: The menu bag is the outer bag containing a list of the components within the MRE.

3. MREs are subject to infestation by boring/chewing insects such as *Rhyzopertha dominica* (lesser grain borer), *Trogoderma variabile* (warehouse beetle), *Lasioderma serricorne* (cigarette beetle), *Tribolium castaneum* (red flour beetle), and *Tribolium confusum* (confused flour beetle). This infestation would most likely occur in MRE cases that are stored for long periods of time and/or those located in the least lighted area of the storerooms or warehouses. Once the integrity of the outer or menu bag has been breached, any small insect can invade the bag. Components are rarely penetrated, however, the insects may explore a poor seal in a component package. Most susceptible components are peanut butter and cocoa beverage powder.

4. The practice of heating entrees in a container of hot water and then using the water for hydration of food or drink is to be discouraged. This is due to the possibility of laminates leaching into the water.

9-23. T-Rations.

1. Tray packs are the main component of T-Rations. They are semi-perishable food items which provide nutritionally adequate hot meals while reducing the manpower, fuel and water requirements for feeding. The tray packs are hermetically-sealed half-size steam table containers in which up to 36 servings of food, depending on product, have been thermally processed and can be transported and stored without refrigeration. Contents can be easily heated in and served directly from the tray packs.

2. The tray pack serves as a storage, heating, and serving vessel. They are heated by immersion in boiling water from 15 to 45 minutes. During heating, some swelling of cans is expected. Overheating (especially vegetable products) causes excessive swelling. If tray packs become extremely cold or frozen from arctic conditions, heating time will have to be adjusted. Frozen tray packs may show degradation of texture when prepared.

3. After initial heating, *unopened* tray packs may be retained for re-use under the following conditions:

a. They must be marked with the time and date of initial heating.

b. They must be used at the *next* meal period or discarded.

Section IV. WASTE DISPOSAL METHODS IN THE FIELD

9-24. Medical lmportance of Waste Disposal. In the field large amounts of all types of wastes are generated each day. If the wastes are not disposed of properly, the camp will quickly become an ideal breeding area for flies, rats, and other vermin. Diseases such as dysentery, typhoid, cholera, and plague could compromise the integrity of the unit. Zoonotic diseases, such as rabies, could occur from exposure to infected animals as they scavenge for food.

9-25. Types of Waste. The term wastes include all types of refuse resulting from the living activities of humans or animals. The following types of wastes will be discussed in this section:

1. Human Wastes (feces and urine)
2. Liquid Wastes (bathing and liquid kitchen wastes)
3. Garbage (peelings, slicings and other semisolid or solid organic material resulting from food service operations)
4. Rubbish (boxes, cans, paper, and plastics)

9-26. Responsibilities.

1. Unit commanders, through the engineering section, are responsible for the disposal of wastes generated within their areas. When waste disposal facilities are not provided, the commander must arrange for their construction, operation and closure.

2. Medical department personnel should provide technical assistance in the fabrication, location, and maintenance of field waste disposal facilities. PREVMED personnel must inspect the facilities prior to their initial use to ensure proper construction and location and then on a daily basis to ensure the facilities are being run in a sanitary manner.

9-27. Disposal of Human Waste.

1. The devices for disposing of human wastes in the field vary with the tactical situation, soil conditions, water table, weather conditions, availability of materials, and local environmental regulations.

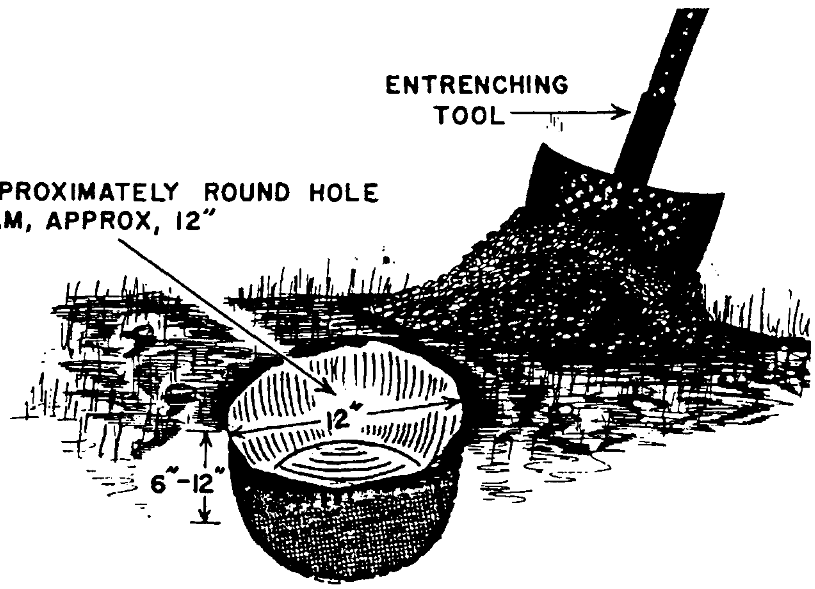
a. When troops are on the march, each person uses a "cat hole" device during short halts. It is dug 8 to 12 inches in diameter and 6 to 12 inches deep and is covered and packed down after use, figure 9-7.

b. In temporary bivouacs (1 to 3 days), the straddle trench, figure 9–8, is used unless more permanent facilities are provided.

c. In permanent camps, one or more of the devices in paragraph 4, below, are constructed. Straddle trenches are used while more permanent facilities are being built. In training situations, portable chemical toilets may be required by local public health law.

2. In determining the type of latrine to be constructed, consideration must be given to the length of stay, the water table, and soil conditions. For example, if the water table is high, then the. depth of a deep pit latrine may cause contamination of underground water supplies. A burn out latrine would be more appropriate in this situation. During peacetime, contact the local public health department prior to use to ensure burning is lawful.

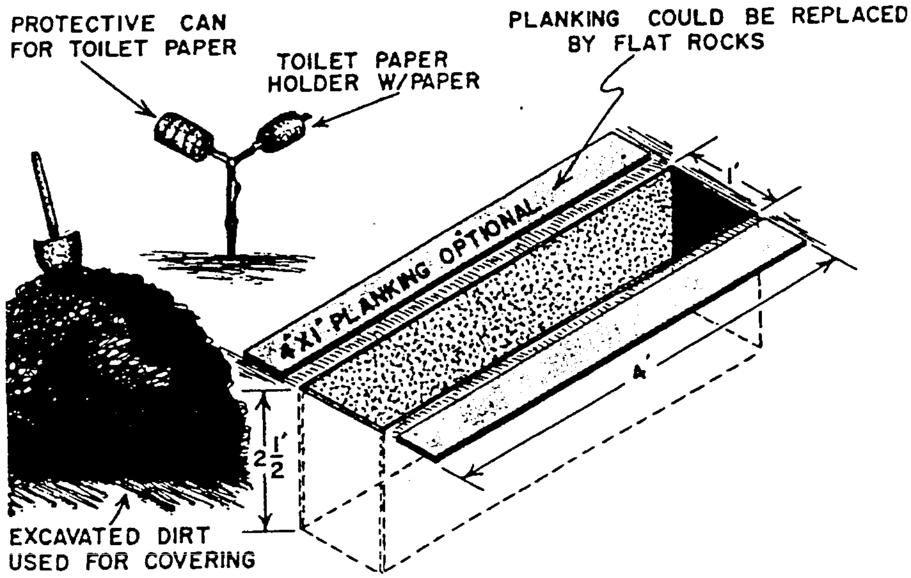
3. In determining the location for latrines, give consideration to protecting food and water supplies from contamination as well as providing convenient accessi-



CAT HOLE

Figure 9-7.

The cat hole is used for the disposal of individual human excreta in situations where other latrines are not available such as when on the march and at short halts. The hole has a diameter of 8 to 12 inches and a depth of 6 to 12 inches. The feces are deposited and immediately covered with tightly compacted earth which was originally removed from the hole.



STRADDLE TRENCH

Figure 9-8.

Trenches are built 1 foot wide, 2½ feet deep, and 4 feet long. Boards may be placed along both sides of the trench to provide footing. Rolls of toilet paper, set on posts, are kept dry covering with cans, as illustrated. Unless there is natural concealment, a wood or canvas screen will be constructed to provide privacy and a wind break. Earth, removed in digging the trench, is piled at one end for prompt covering.

bility. Select a location which is at least 100 feet from the nearest natural water source, at least 100 yards from food service areas, and 50 feet from berthing areas. Common sense implores that the selected site be reasonably near the user.

4. Design and Construction of Human Waste Disposal Devices

a. Straddle Trench Latrine. This temporary latrine is made by digging a trench 1 foot wide, 2½ feet deep and 4 feet long. It will serve 25 people and accommodate two people at one time. Additional trenches will be at least two feet apart. There are no seats in this type of latrine, but boards may be placed along both sides of the trench to provide better footing. The removed earth is placed at the end of the trench and each person promptly covers their excreta and toilet paper using their own entrenching tool. The trench will be closed when filled to within one foot from the top of the trench. To close, spray the excreta with an approved insecticide, fill the trench with several layers of dirt compacting each layer, and mound the dirt at least one foot above ground level. Tactical situation permitting, post a sign indicating the type of latrine and the date closed, figure 9–8.

b. Deep Pit Latrine. This temporary latrine is made by constructing a latrine box over a pit. The standard latrine box has four holes (seats), is 8 feet long and 2½ feet wide at the base, and is mounted on two 6-inch planks. One, 4 seat, deep pit latrine is required for every 50 people. Seats will be covered with fly-proof, self-closing lids. Cracks in the wood will be fly-proofed by nailing strips of wood or metal over the openings, sandbagging, or by using oil soaked burlap. A metal deflector will be secured to the inside surface of the front panel of the box to prevent urine from soaking into the wood. Skin contact surfaces will be sanded smooth. The pit is dug 2 feet wide and 7½ feet long and up to a maximum of 6 feet deep. (Alternately, a 5 foot square, 4 seat latrine can be placed over a 4 foot square pit up to 6 feet deep). As a guide, allow 1 foot of depth for each week of planned usage and one foot for dirt cover. Close as noted in 4.a. above, figure 9-9. The deeper the pit, the greater the chances of it caving in!

c. Burn-Barrel Latrine. The burn-barrel (burn out) latrine has been used extensively over the past several years in major operations. It is desirable where the soil conditions are hard, rocky or frozen making digging difficult and where water tables are high. A screen (#18 mesh) enclosed building can be constructed of plywood, and suitable framing lumber. This structure usually contains 2 to 4 toilet seats built over 55 gallon drums that are cut in half. A burn barrel is placed under each seat. Note correct placement of barrels in Figure 9–10. All barrels will be “primed” with 3 inches of diesel fuel prior to placing them into service. This allows the fecal matter to become oil soaked enhancing complete thermal destruction of fecal matter during the daily (or more often if needed) burn out process. The oil also serves as an insect repellant and obnoxious odor deterrent. (Caution!! Ensure that “NO SMOKING” is conspicuously posted inside and outside of the structure)

When a barrel is 1/2 to 2/3 full it must be removed from the structure and burned out. Encourage personnel

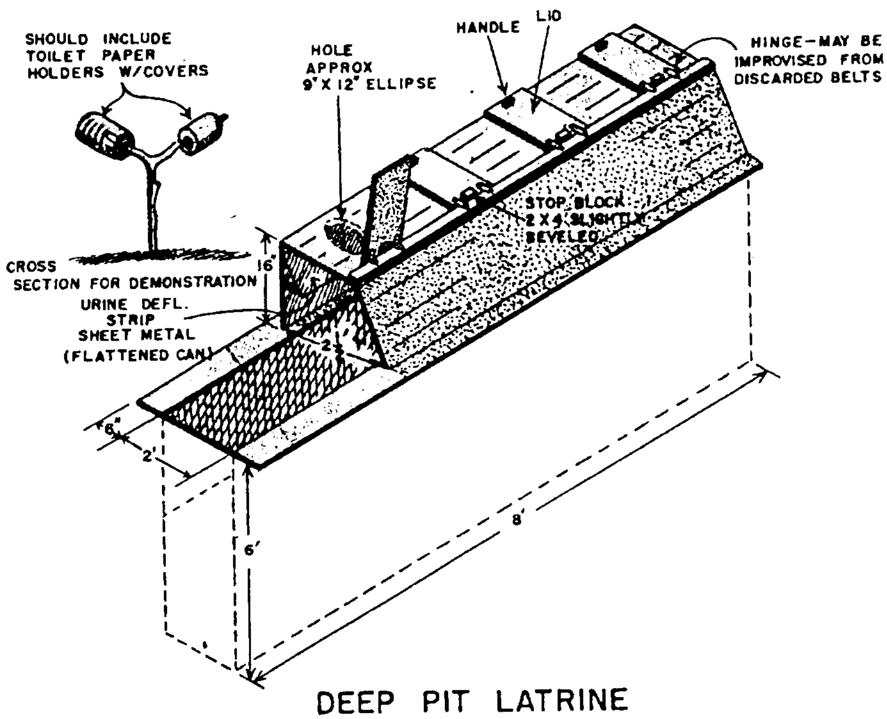
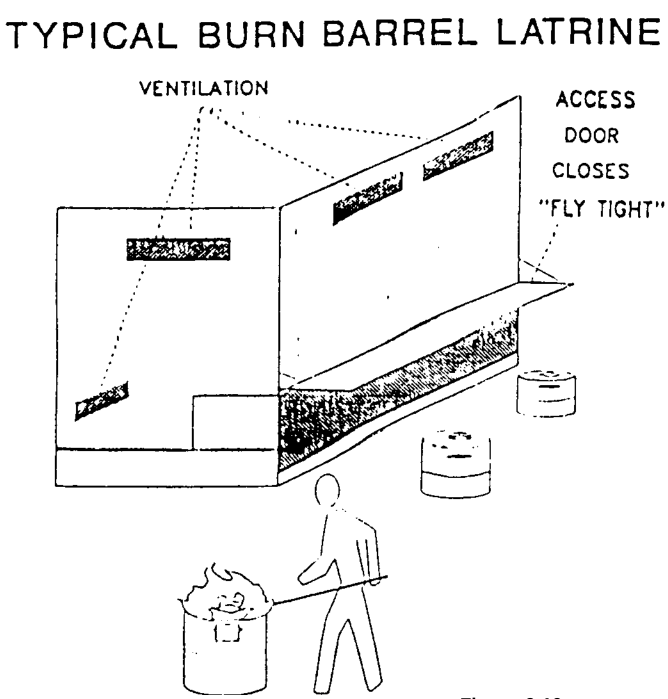
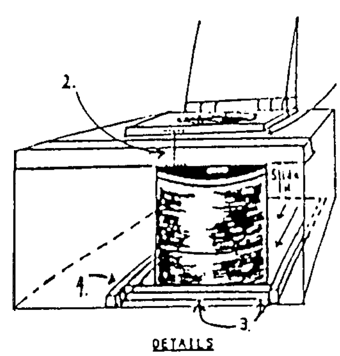


Figure 9-9.

A pit, 7½ feet long and 2 feet wide, is dug to conform to the standard size latrine box which is 8 feet long and 2½ feet wide. The depth of the pit will depend on the length of stay. The illustration shows stop blocks, to ensure self-closing lids, a metal urine deflector strip, and a method of keeping the toilet paper dry. It is best to provide a separate urinal at each male deep pit latrine.





1. FORWARD EDGE OF HOLE SHOULD BE WELL BACK FROM THE EDGE OF THE BENCH(4-6").
2. TOP RIM OF BARREL SHOULD BE NO MORE THAN 2" FROM UNDERSIDE OF SEAT. (MORE THAN 2" WILL RESULT IN SPLASHING AND SPILLAGE INTO COMPARTMENT.)
3. THE BARREL SHOULD BE PUSHED ALL THE WAY BACK AGAINST THE BACK STOP WHICH HELPS TO CENTER CAN UNDER HOLE.
4. RUNNERS AID TO CENTER BARREL UNDER HOLE TO PREVENT SPILLAGE.

Figure 9-10.

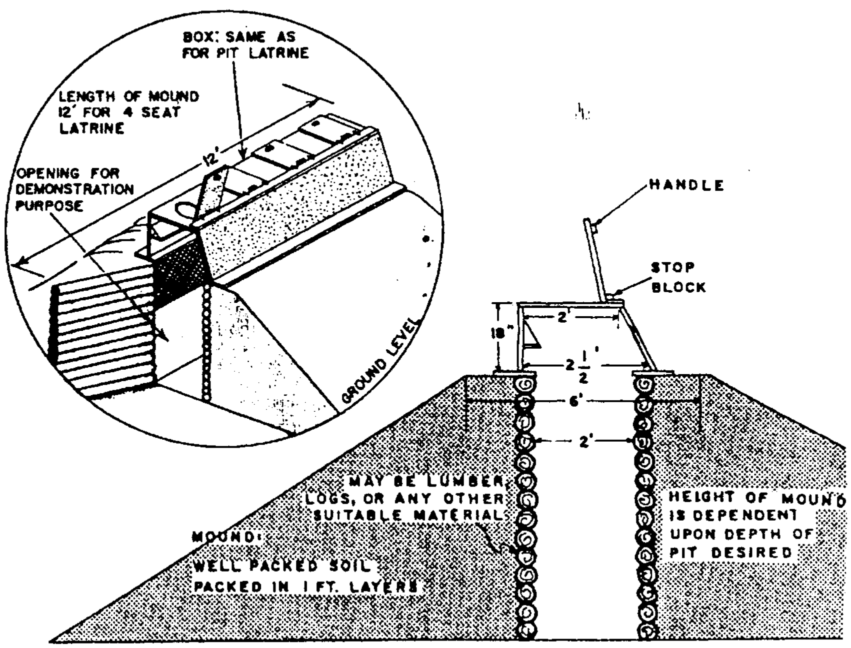
to use urine soakage pits or other methods of urine disposal instead of burn barrel latrines since additional fuel will be required to promote complete burning. Mix 4 parts diesel fuel to one part gasoline (mogas) until the contents of the barrel is sufficiently covered. Ignite the barrel with a long stick or pole used to stir the mixture. Sticks or poles that are less than 4 feet in length must be replaced. Burning must be continued until the contents of the barrels are reduced to a fine ash, which may take more than one attempt. Burial of ashes to a depth of 12 inches is acceptable. Scattering the ashes over ground surfaces is not recommended.

d. Mound Latrines. These temporary latrines are indicated when higher ground water levels or rock formations prevent the digging of a deep pit. By mounding the earth, it is possible to then dig a deep pit and still not intrude into the groundwater or rock. The top of the mound is at least 6 feet wide and 12 feet long so that a standard 4 seat latrine box can be placed on top of it. The mound is formed in approximately 1 foot layers with the surface of each layer compacted prior to adding the next layer. When the mound has reached the desired height, a deep pit is dug into it. The side walls are reinforced with timbers or scrap wood, figure 9–11.

e. Bored Hole Latrines. These temporary latrines require specialized drilling equipment and are, therefore, seldom used. An 18 inch diameter hole is bored to a depth of 15 to 20 feet. The hole is covered with a one seat latrine box and fly-proofed. Bored hole latrines are constructed on the basis of 8 per 100 people, figure 9–12.

f. Urine soakage pit. This temporary latrine is most effectively used in sandy soils. It is dug 4 feet square by 4 feet deep. The pit is filled to within 6 inches of ground level with any of the following materials; large rocks, flattened tin cans, broken bottles, rubble, bricks or other suitable contact material. Ventilation shafts will be inserted into the pit to within 6 inches of the bottom. The shafts will extend 6 to 12 inches above ground level. This allows air to circulate through the-pit and lessens odors. Six urine tubes, made of 1 inch by 36 inch pipe, are then inserted into the pit. The tubes are inserted, at a slight angle, about 8 inches below ground level, which leaves about 26 inches above ground level. A screened funnel, made of moisture proof material, is placed in the top of the tube. Oil soaked burlap is then spread over the pit and covered with 6 inches of compacted earth. One pipe will accommodate 20 men, figure 9-13.

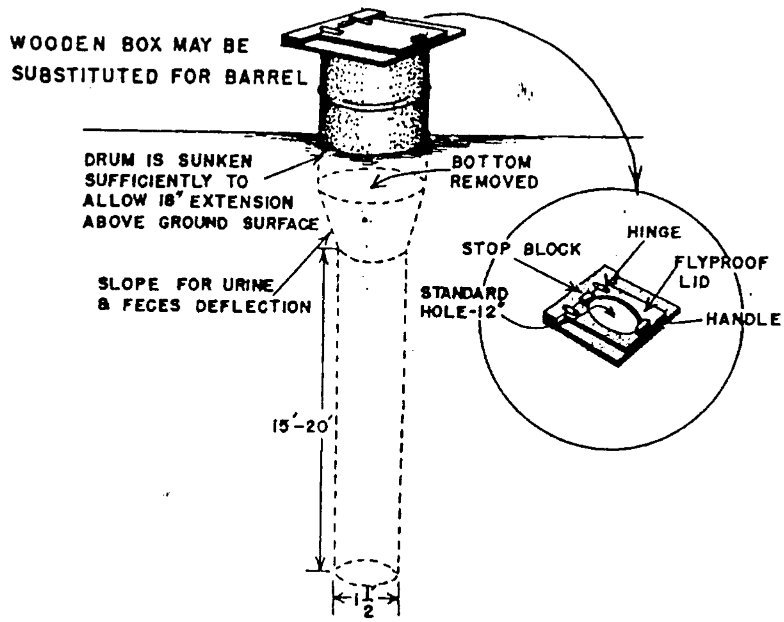
g. Urine Troughs. This type of latrine is made when construction materials are readily available. A 10 foot long, “V” or “U” shaped trough is made of sheet metal or wood. Wooden troughs are lined with moisture proof materials. A splashboard is inserted in the middle of the trough. A drain trough or pipe is attached to one end to drain urine into a soakage pit. One urine trough is designed to serve 100 men, figure 9-14. Construct it so the side with the drain trough or pipe is slightly lower than the other to ensure proper drainage.



MOUND LATRINE

Figure 9-11.

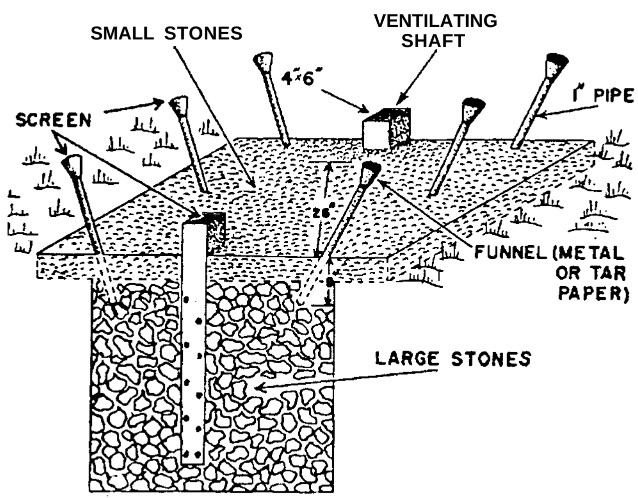
This latrine may be used where ground characteristics (high water table, frozen or rocky ground) are such that a deep pit latrine cannot be constructed. After a crib of timbers or wood planking is built, earth is compacted around the “pit” to form a mound.



BORED HOLE LATRINE

Figure 9-12.

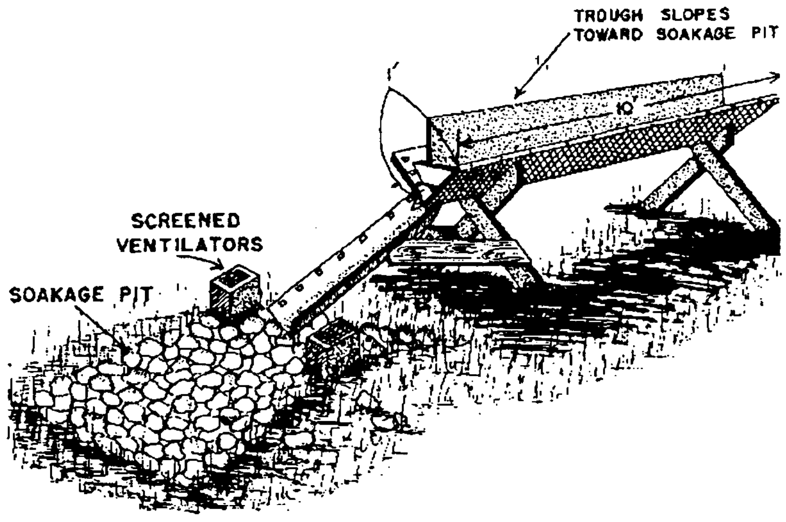
This latrine may be used for small units in isolated areas if facilities are available for boring the deep hole. Because mechanical equipment is required for its construction, it is not too often utilized.



URINE SOAKAGE PIT

Figure 9-13.

This reproduction shows salvaged pipe and improvised funnels and depicts a soakage pit with a cross section view showing construction. This pit is filled with rocks, flattened cans, broken bottles, bricks and other material. For clarity of illustration, the 6 inches of earth covering the oil-soaked burlap have not been shown. Note the same ventilating shafts as shown on the illustration of the soakage pit. (The shafts, with the openings screened, extend from 6 to 12 inches above the surface of the pit to within 6 inches of the bottom of the pit.) The surfaces of the shafts that extend below the level of the ground are perforated with one inch holes.



TROUGH URINAL

Figure 9-14.

This figure illustrates a trough urinal with splashboard and soakage pit. This urinal is made of wood and tar paper, or may be improvised of tin, galvanized iron, or any other suitable material.

h. Urinoils. These permanent type latrines are very sanitary and less odorous than other urine disposal methods. The urinoil is a screened 55 gallon drum designed to receive and trap urine and to dispose of it into the soakage pit. Urine entering through the screen is deposited on a surface of waste oil and then sinks to the bottom. As urine is added, the liquid level rises in a 3 inch diameter pipe until it overflows into a 1½ inch diameter pipe which drains into the soakage pit. The oil acts as an effective barrier against odors and flies. A covered windbreak must be constructed around the urinoil to protect it from flooding with rain water. Fresh sand or dirt must be spread around the barrel periodically. One urinoil serves 100 men, figure 9-15.

i. Chemical toilets. This type of latrine is usually obtained as a contracted service. Close scrutiny of the contractor's pumping and cleaning services is mandatory for maintaining sanitary facilities. PREVMED personnel will maintain a current telephone number for the contract service. When used, chemical toilets will be ordered at the ratio displayed in Table 9-6.

Chemical Toilet Requirements

# of Personnel	# of Chemical Toilets
1 to 15	1
16 to 35	2
36 to 55	3
56 to 80	4
61 to 110	5
111 to 150	6
Over 150	Add 1 toilet for each additional 40 persons.

Note: When females are not involved in the exercise, urinals may be substituted for some of the seat type latrines. The number of seats, in such cases, will not be reduced to less than 2/3 of the number specified in this chapter.

Table 9-6.

5. Maintenance of Latrines

a. After latrines have been constructed, they should be enclosed in shelters to facilitate insect control, routine cleaning, privacy, and protection from flooding with rain water.

b. To prevent surface runoff from flooding the latrines, dig drainage ditches around them.

c. Provide sufficient amounts of toilet paper daily. Protect the paper from moisture, i.e. cover rolls with inverted tin cans.

d. Install a simple, easily operated, hand washing device outside each latrine, and keep these devices filled with hand soap and potable water.

e. Sweep and scrub all surfaces of each latrine daily. Disinfect the seats with a mild chlorine solution.

f. Provide a convenient trash receptacle inside latrine enclosures and empty daily.

g. Provide and maintain butt kits outside each latrine and empty daily.

h. Construct urine tube screens in the shape of a cone. Install with the apex of the cone pointing up.

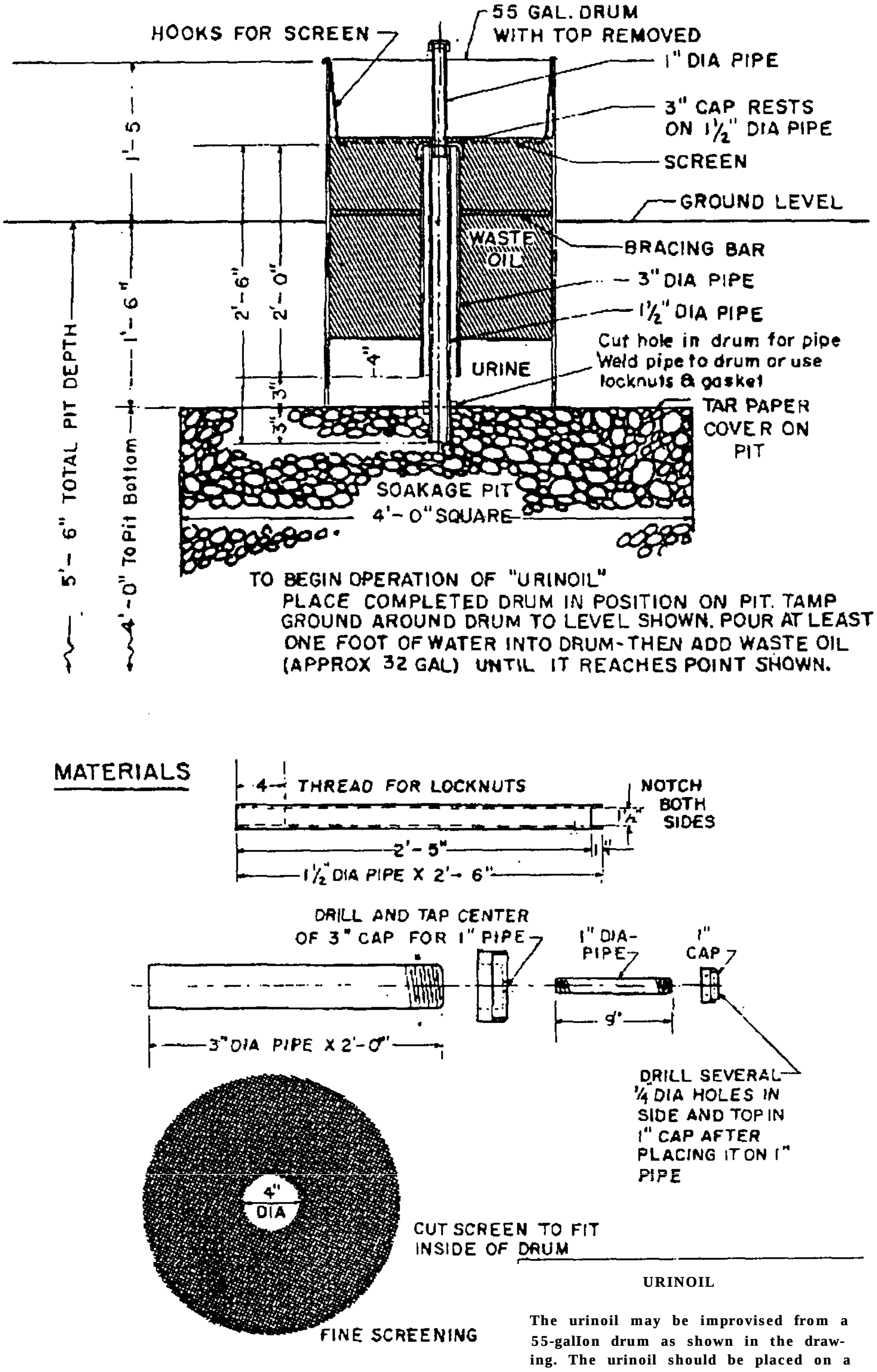
i. Keep doors and seat lids closed when not in use.

j. Mark or number each latrine to facilitate the cleaning and inspection schedules.

k. When a latrine pit becomes filled with wastes to within 1 foot of ground level, or if it is to be abandoned. Close the latrine as follows:

(1) Using an approved, residual insecticide, spray the pit contents, the side walls and the ground surface for about 2 feet extending out from the mouth of the pit.

(2) Fill the pit to ground level with successive



URINOIL

The urinoil may be improvised from a 55-gallon drum as shown in the drawing. The urinoil should be placed on a soakage pit when possible, or installed wilh a French drain.

Figure 9-15. Urinoil

layers of earth, packing each layer down before adding the next one. Then mound the pit over with at least one foot of compacted dirt, and spray again with insecticide.

(3) When the tactical situation permits, mark the closed latrine by placing a rectangular sign on top of the mound stating, "LATRINE CLOSED (date)."

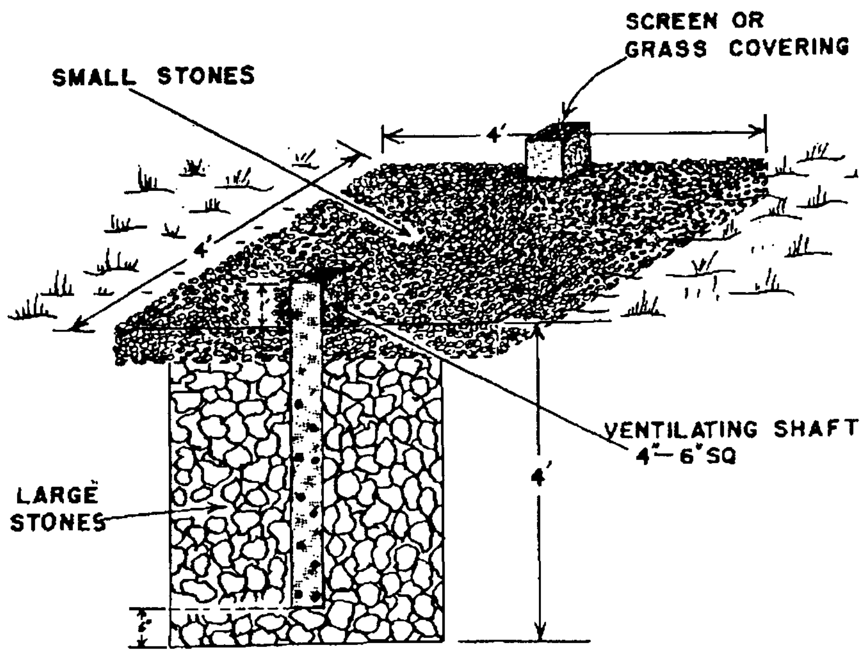
9-28. Disposal of Liquid Waste.

1. In the field, bathing and liquid field mess wastes are disposed of in the soil by means of either a soakage pit or soakage trench. In order for the soil to absorb liquid field mess wastes the grease, scrap food, and other suspended solids must first be removed. Grease traps are designed for this purpose and must be constructed between the field mess and each pit, trench, or evaporation bed. In places where heavy clay prevents the use of soakage pits or trenches and the climate is sufficiently hot and dry, evaporation beds are used. In either case, inspections should ensure standing water does not lead to the breeding of disease vectors.

2. Design and Construction of Liquid Waste Disposal Devices:

a. Soakage pits, for field messes, are constructed like urine soakage pits (without urine tubes), that is, 4 feet square, 4 feet deep and filled with a suitable contact medium. One soakage pit will service a field mess serving 200 people or less. If the mess is to remain operational for 2 weeks or more, two pits will be constructed and used on alternating days. Each washing or drinking device will have a soakage pit under it. Pits are also recommended under water trailers. These pits may vary in size depending on the size and water volume of the device, figure 9-16. Soakage pits will eventually become clogged. When this happens, simply close the pit and dig a new one. A soakage pit is closed in the same manner as a urine soakage pit and marked, "SOAKAGE PIT CLOSED (date)."

b. Soakage trenches are used when the groundwater level or a rock formation prevents the use of a soakage pit. A soakage trench consists of a central pit which is 2 feet square and 1 foot deep. A trench is dug outward from each side of the pit. The trench is at least 6 feet long, 1 foot wide and 1 foot deep at the end nearest

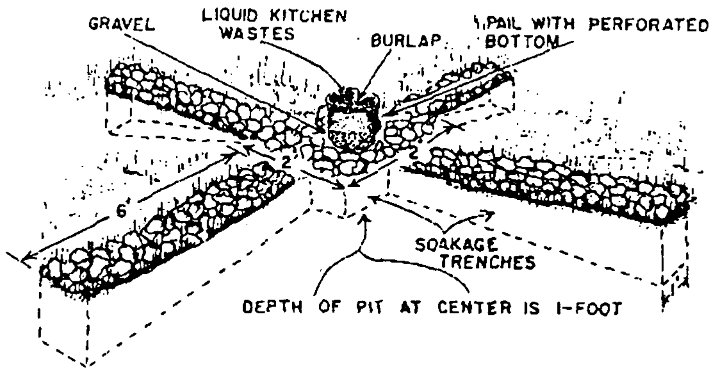


SOAKAGE PIT

Figure 9-16.

The soakage pit is used to dispose of all types of liquid wastes where the soil is capable of absorbing moisture. The pit is dug 4 feet square and 4 feet deep. The hole is filled with any of the following materials: rocks, flattened tin cans, rubble, bricks, broken bottles, or any other suitable contact material. The liquid waste is held in void spaces until it seeps into the ground. A layer of small gravel or crushed stones may be placed on the surface of the stone.

Ventilating shafts made of scrap materials 4 to 6 inches square may be used but are not essential to satisfactory operation of a soakage pit. When the shafts are used to introduce sir into the pit, they extend 6 to 12 inches above the surface and to within 6 inches of the bottom of the pit. Numerous holes are interspersed in the sides of the underground sections. The top of these shafts are covered by screen, strew, or grass.



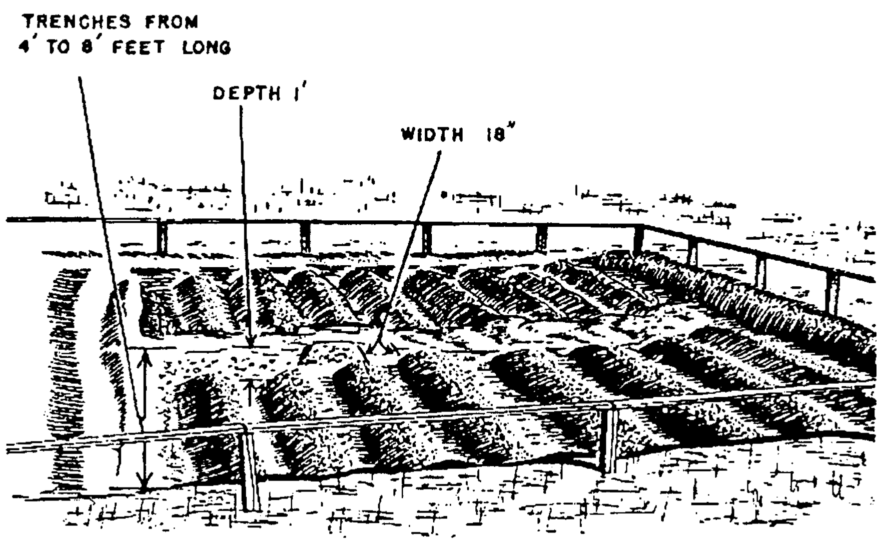
PAIL GREASE TRAP

Figure 9-17.

This grease trap utilizes crossed soakage trenches and a pail. For normal operation, two such devices will be constructed and used on alternate days.

the pit with a gradual downward slope to 1½ feet deep at the end farthest away from the pit. The bottom of the structure is filled with a suitable contact medium such as small rocks. Trenches are closed in the same manner as soakage pits. Figure 9–17 shows a soakage trench with a pail type grease trap.

c. Evaporation beds are constructed to allow 3 square feet of evaporation area per person, per day, for field mess wastes and 2 square feet per person, per day, for bathing wastes. Each bed is constructed in the same manner and spaced so that wastes can be easily distributed to any one of them. An 8 foot by 10 foot rectangle is marked off. The top soil is scraped and used to form a dike around the perimeter of the bed. The bed is then spaded to a depth of 10 to 15 inches and raked into a series of ridges and depressions with the ridges about 6 inches higher than the depressions. In operation, one bed is flooded with liquid wastes to the top of the ridges. This



EVAPORATION BED

Figure 9-18.

This sanitary device is used to dispose of liquid kitchen wastes in locations where soakage pits and grease traps are impractical. Evaporation beds are recommended for periods of short duration in hot, dry climates where soakage pits cannot be dug or where the soil is too hard (frozen or rocky) to absorb moisture.

is equivalent to an average depth of 3 inches over the bed. The liquid wastes are then allowed to evaporate and percolate. After 3 or 4 days, the bed is usually dry enough to permit respading and reforming. Other beds are flooded on successive days and the same sequence of events is followed, figure 9–18.

d. Grease traps must be constructed between the field mess and each soakage pit, trench or evaporation bed.

(1) Filter grease trap. A 55 gallon drum, with the top removed and the bottom perforated is used. It is filled two thirds full with three layers of material. Crushed rock or large gravel is placed on the bottom, progressively smaller gravel in the middle, and a 6 inch layer of sand, ash, charcoal or straw is placed on top. The top of the drum is covered with burlap to strain out the larger pieces of debris. The burlap is removed daily, burned or buried, and replaced with a clean piece. The internal filtering material is removed, buried, and replaced at least once a week. The barrel will be installed in the center of a soakage pit or trench about 2 inches below ground level, figure 9-19.

(2) Baffle grease trap. The baffle grease trap is the most effective device for removing grease. It consists of a watertight container divided into three equal sized chambers by hanging baffles. The lower edge of the first baffle hangs to within 1 inch of the bottom of the container. The second baffle hangs to a point half the depth of the box. The outlet pipe (2" diameter) is inserted 6 to 8 inches below the upper edge of the last (exit) chamber and extends outward to the center of and 1 foot below the surface of a soakage pit or trench. The outlet pipe may also terminate in an evaporation bed. The liquid waste is strained before it flows into the entrance chamber of the trap. Before the trap is put into service, it is filled with cool water. The cool water causes the grease to solidify and rise to the surface where the baffle prevents it from reaching the outlet and flowing into the soakage area. The trapped grease is skimmed from the first (entrance) and second chamber at least daily and buried. The trap must be emptied and scrubbed with hot, soapy water as often as necessary to keep it operating efficiently, figure 9-20.

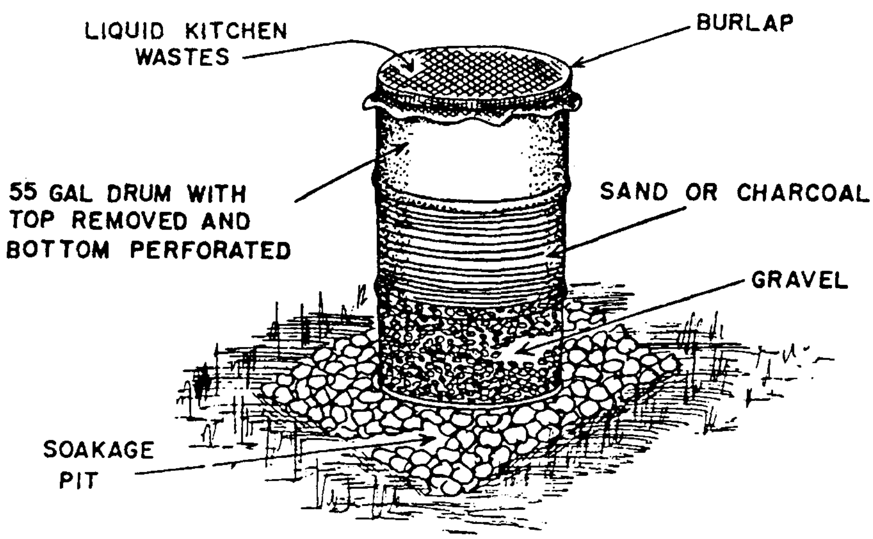
9-29. Garbage Disposal.

1. Garbage is the solid or semisolid wet wastes resulting from the preparation, cooking and serving of food.
2. Garbage is disposed of by burial or incineration. In either case, the tactical situation must be considered before proceeding.

a. Burial, When troops are on the march or in camps for less than one week, garbage is disposed of by burial in pits or trenches. Burial must be at least 100 feet away from any natural water source and from the field mess (further if insects, vermin or odor become a problem).

(1) Pits. Pits are preferred for overnight halts. They consist of a 4 foot square pit that is 4 feet deep and will service 100 people for one day. When the pit is filled with garbage to within 1 foot from the top, it is covered with compacted dirt and mounded with an additional 1 foot of dirt.

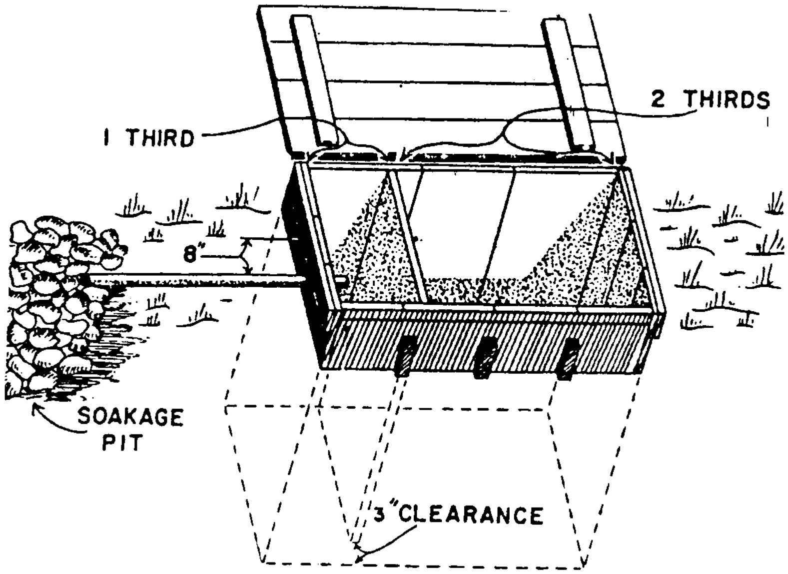
(2) Continuous trench. A continuous trench is used for stays of 2 days or more. The trench is dug 2 feet wide, 4 feet deep and long enough to accommodate the



FILTER GREASE TRAP

Figure 9-19.

This grease trap may be used in place of the baffle type. It will effectively remove grease from liquid kitchen waste, although the top layer of sand will require frequent replacement.



BAFFLE GREASE TRAP

Figure 9-20.

In this illustration the box-type baffle grease trap is shown. A baffle may be used in a box, drum, or barrel in the construction of a grease trap. Salvage boxes or barrels may be reinforced and/or treated to serve this purpose. One baffle extends half the depth of the box and the other baffle extends within one inch of the bottom of the box. The water is poured into the box on the side nearest the half baffle and the grease remains on the surface of the first two sections of the trap. The pressure of the fluid forces the grease free water under the last baffle board and out the pipe into the soakage pit.

next day's garbage. When the first section is full, it is covered and mounded, then another section is dug to accommodate the next day's garbage. The process can be repeated indefinitely.

b. Incineration. Incineration is the garbage disposal method often used in camps that will be used for 1 week or more. Wet materials will not burn easily and tend to disrupt the incinerator air draft. Therefore, it is necessary to separate the liquid from the solids. Separation is done by straining the garbage through a coarse strainer such as an old bucket or 55 gallon drum with holes punched in the bottom. The liquid is run through a grease trap and into a soakage pit. The solids are incinerated. Incinerators must be located at least 50 yards from the camp area and away from flammables.

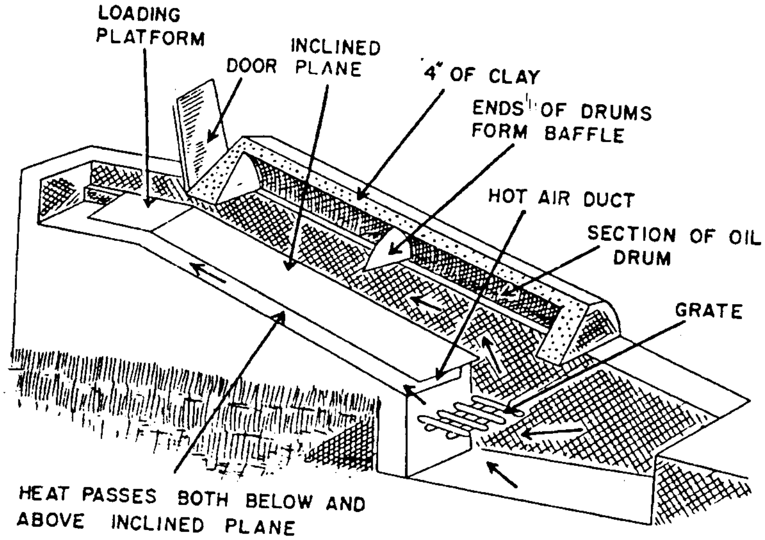
(1) Inclined plane incinerators will handle the garbage of an entire battalion. Their effectiveness in combustion and the fact that they are somewhat protected from wind and rain makes them excellent improvised devices. A sheet metal plane is inserted through three telescoped 55 gallon drums from which the ends have been removed. The drums are laid on an incline. The metal plane is extended about 2 feet beyond the upper end of the inclined drums and serves as a loading or stoking platform. A grate is placed at the lower end of the inclined drum/plane mechanism. A wood or oil fed fire is provided under the grate. After the incinerator becomes hot, drained garbage is placed on the stoking platform. As the garbage dries, it is pushed down the plane in small amounts and is burned on the grate, figure 9-21.

(2) Barrel incinerators. A barrel incinerator is made from a 55 gallon drum by cutting out both ends, punching many holes near the bottom, and inserting metal rods or small pipes through the barrel, several inches above the holes. The metal rods serve as a grate; the punched holes allow for air draft. The barrel is supported several inches above the ground on stones, bricks, or dirt filled cans so that a fire can be built under it. Drained garbage is added in small amounts and burned, figure 9-22.

9-30. Rubbish Disposal.

1. Rubbish is dry, disposable waste resulting from almost all of man's activities.

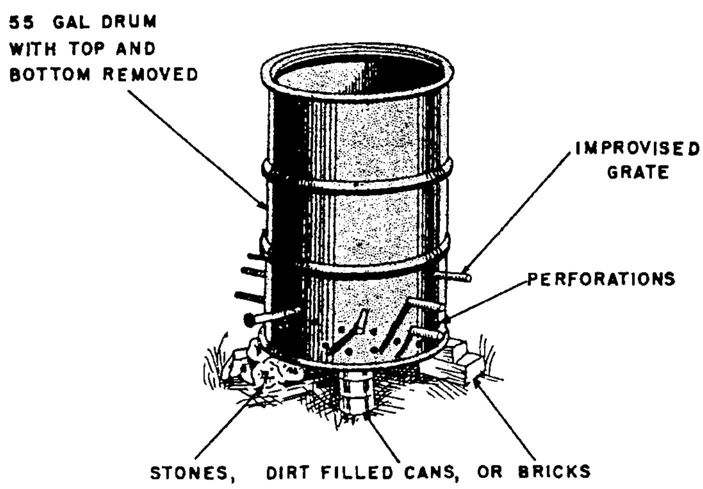
2. Rubbish which for tactical reasons cannot be hauled to a proper disposal site is either buried or incinerated depending on the field situation. For short stays, rubbish is buried in pits with the garbage taking care to flatten cans and break down boxes. In camps where the length of stay is expected to be over one week, the rubbish is incinerated, and the ash and noncombustibles are buried with the garbage. Barrel incinerators are commonly used for rubbish incineration.



INCLINED PLANE INCINERATOR

Figure 9-21.

This incinerator can be very useful in temporary camps. Garbage is placed on the loading platform and fed continuously down the inclined plane towards the grate. This device is particularly useful for burning wet garbage in places where it cannot be buried.



BARREL INCINERATOR

Figure 9-22.

This incinerator is easily improvised and will effectively consume small amounts of garbage and combustible refuse. A grate is made of scrap pipe inserted in the holes as shown. An alternate method is to create a grate by simply punching holes in the bottom of the barrel. Instead of trenches to supply draft, the barrel could be elevated on supports of bricks or stones.

Section V. PREVENTION OF HEAT INJURIES

9-31. General. Heat injuries are a major threat to field operations, and will be discussed briefly in the following section. The internal temperature of the human body is regulated within a vary narrow range. High internal temperatures produce stress on the body which, if not effectively counterbalanced, may result in heat injury or death (See figure 9-23). Environmental as well as physiological factors influence the body's thermal equilibrium mechanism. A detailed discussion of heat stress, its identification, treatment and prevention is contained in Chapter 3 of this manual.

9-32. Environmental Factors.

1. Ambient air temperature dictates the direction of heat flow from (or to) the body. When air temperatures are below normal body temperature, heat loss to the surrounding environment is rapid. When air temperatures are high the body can only dissipate heat by sweating where the heat is carried away by sweat evaporation at the skin surface.
2. Wind velocity. Body heat is carried away by air currents. The higher the velocity of these currents, the faster the heat loss. The rate of heat loss diminishes as air temperatures increase. When the body stops sweating (as in heat stroke), the condition reverses itself and the body absorbs heat rapidly. High wind velocity can also produce windburn which will influence thermal regulation.
3. Humidity. Ambient air, at any given temperature, can only absorb so much moisture. When the moisture content (humidity) of the air is high, sweat evaporates slowly and the rate of heat loss is diminished. When humidity is low, sweat evaporates quickly and the rate of heat loss is rapid.
4. Radiant heat is the heat produced by the reflective energy of the sun or equipment in close proximity to a human body. The radiated heat is absorbed into the surrounding air or directly into the body. In either case, the body's ability to cool itself is hampered.

9-33. Physiological Factors. Predisposing factors which may adversely effect heat injury prevention are:

1. Illness. Personnel suffering from or recovering from an acute or chronic disease.
2. Previous history. Personnel who have a history of heat illness (exhaustion, stroke or cramps).
3. Skin trauma. Personnel suffering from sunburn, heat rash or other dermatologic malady. The body's heat regulatory mechanism is hampered at the skin surface.
4. Dehydration. Individual's fluid output is greater than fluid intake. Causes include vomiting, diarrhea and insufficient water intake.
5. Fatigue. Physical and mental weariness can cause a lack of concern and result in a failure to take proper precautions against heat injuries.
6. Obesity. Body fat will interfere with the heat regulatory mechanism, cause the individual to expend more energy to accomplish a given amount of work and could be an indicator of poor physical conditioning.
7. Poor physical conditioning.
8. Alcohol and drug use. Alcohol and certain medications, including immunizing agents, decongestants and allergy remedies interfere with the body's heat regulatory mechanism. Alcohol should not be consumed for 24 hours prior to heat stress.
9. Sickle cell trait. Sickling of blood cells impairs circulation and increases risk of injury. Persons with sickle cell trait should be advised of their risks and preventive methods.

9-34. Types of Heat Injuries. The type and number of heat injuries anticipated changes with environmental and physical factors. The spectrum of heat illnesses ranges from mild to severe as body temperature increases as seen in figure 9-23 below. Table 9–7 summarizes prevention, symptoms and treatment methods for each type of heat injury.

1. Heat cramps. These are painful and severe cramps of the voluntary muscles, primarily in the extremities

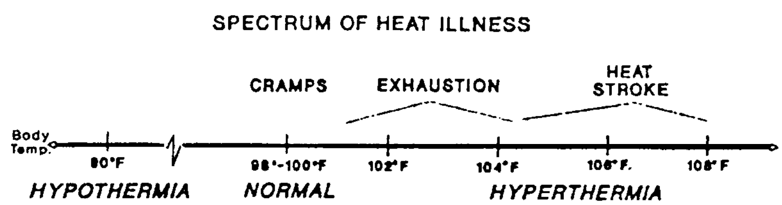


Figure 9–23.

HEAT ILLNESS SUMMARY

HEAT ILLNESS	PREVENTION	SYMPTOMS	TREATMENT
CRAMPS	Training-Education Pre-Exercise Hydration Conditioning-Salt Foods	Muscle Contraction in Legs and Arms	Stop Exercise- Hydration-Extension
EXHAUSTION	Training-Education	N&V-Vertigo-Syncope- Dyspnea Body Temp < 104°F	Loosen Clothing-Monitor Temp. Rectally-Water Spray-Fan-Shade- Replace Fluids-Transport
HEAT STROKE	Training-Education Physical Conditioning	Confusion-Disorientation- Drowsiness-Irrational Behavior, Body Temp > 104° F	Emergency Cooling- Water Spray-Fan-Shade- Water-IV Fluid Replacement Transport
HEAT SYNCOPE	Training-Education Physical Conditioning	Fainting or loss of consciousness while standing in the heat	Emergency Cooling Water Spray-Fan-Shade- Water-lV Fluid Replacement-Transport

Table 9-7.

and abdominal wall. Heat cramps result primarily from the excess loss of salt through sweating. The body temperature remains normal “unless accompanied by heat exhaustion. Treatment includes cooling and fluid/ electrolyte replacement.

2. Heat Syncope. Heat syncope occurs when there is excessive pooling of the blood in the extremities, consequently the brain does not receive enough blood. There is peripheral vasodilation to dissipate the heat and if personnel have been standing still they are likely to faint. This is most likely to occur when standing after a march or exercise. Heat syncope may be avoided by not requiring personnel to stand still in the heat, particularly after exercise.

3. Heat exhaustion. Heat exhaustion results from peripheral vascular collapse due to excessive water and salt depletion. Symptoms include profuse sweating, headache, weakness, pallor, nausea, vomiting, mild dyspnea, and palpitations. The casualty may become faint and lose consciousness. The blood pressure may be low, the body temperature may be elevated or normal and the pupils may be dilated. Treatment includes cooling and fluid replacement, taking care that the victim does not go into hypothermia. Heat exhaustion should not be treated with aspirin, or other antipyretics.

4. Heatstroke. **HEATSTROKE IS A MEDICAL EMERGENCY!** It is the result of the collapse of the thermal regulatory mechanism. Early symptoms may include dizziness, weakness, nausea, headache, confusion, disorientation, drowsiness and irrational behavior. The skin may be hot and dry or there may be profuse sweating. The casualty may progress through the symptoms of heat cramps and heat exhaustion with the onset of heatstroke occurring with dramatic suddenness. There may be collapse and loss of consciousness; profound coma and convulsions may occur. Body temperatures rise to the critical levels above 104° F, and may reach 108° F. Treatment must be administered within minutes or irreversible damage or death will occur. Treatment includes **IMMEDIATE** cooling and evacuation to a medical treatment facility. Remove or loosen the casualty's clothing, move to a shaded area, spray or splash with water, rub with ice, (if available); fan to aid the cooling process, take whatever action is necessary to lower the body temperature and do it quickly. Take care that the victim does not go into hypothermia. If a thermometer is available core temperature as measured rectally should be taken as early as possible and monitored continuously. Taking the temperature orally is inadequate. Intravenous normal saline should be given as soon as possible and continued to guard against possible myoglobin-induced renal failure. Heat stroke should not be treated with aspirin or other antipyretics.

9-35. Prevention. The successful prevention of heat injuries depends largely on education of personnel, especially supervisory personnel. Equally important is the development of procedures to alert individuals to the existence of dangerous heat stress levels. The application of measures to reduce both the severity and duration of exposure and adoption of techniques to increase the resistance of exposed persons are:

1. Acclimatization. A period of three weeks is optimal

for acclimatization, with progressive degrees of heat exposure and physical exertion. Note that acclimatization at one level of heat stress does not guarantee any level of acclimatization at higher levels of heat stress.

2. Water Intake

a. Adequate water intake is the single most important factor in avoidance of heat injury. The human body is highly dependent on water to cool itself in a hot environment. An individual subjected to high heat stress may lose in excess of one quart of water per hour by sweating. This loss must be replaced or rapid rise in body temperature and heart rate may occur. This also decreases the ability and motivation to work, and deterioration in morale may occur. These are good indicators of impending heat injury.

b. Personnel exposed to heat must consume water frequently, preferably at 10 to 20 minute intervals. Water should be consumed before, during, and after exercise. The theory that personnel can discipline themselves to do without water is inaccurate and the practice can be deadly.

c. Thirst is not a reliable indicator of the body's need for water. Personnel with ample water supplies will frequently dehydrate by one or two quarts unless drinking water is encouraged or required. Personnel must be trained to drink liberal quantities of water even though they do not feel thirsty. Mandatory water consumption monitored by unit leaders and assigned medical personnel (water discipline) will be required during periods of extreme heat stress exposure. Individuals should be instructed to note the color of their urine. The color should be straw to clear. Dark colored, concentrated urine suggests dehydration.

d. When the WBGT index is above 80 degrees F, water requirements can range from 8 to 10 quarts per person per day, doing light work (i.e., desk work), to 13 to 19 quarts per person per day doing heavy work (i.e., forced march). When water is in short supply, water savings can be made only by reducing physical activity, or limiting it to the cooler hours of the day. Any attempt at water economy by restricting water intake must be paid for in reduced work capability, reduced efficiency and the increased risk of heat injury.

e. The optimum temperature for drinking water is between 50 and 60 degrees F.

3. Salt Intake. In addition to water, salt (sodium chloride) is lost in sweat. An adequate diet is essential to health and normally contains an adequate amount of salt intake when personnel simply salt their food to taste. Salt supplements are not necessary. Unsupervised, routine consumption of salt tablets is contraindicated.

4. Clothing

a. Except when exposed to the direct rays of the sun, an individual in a hot environment is better off wearing the least allowable amount of clothing. Clothing reduces the exposure of the skin to sunlight, but will decrease the movement of air over the surface of the skin.

b. Clothing should be loose fitting, especially at the neck, arms, waist and lower legs, to permit circulation of air, the exception being that trousers must be tucked inside the boots and blouses inside the trousers when operating in an area of tick and mite infestation.

c. Field uniforms must not be starched. The starch blocks the fabric pores and restricts air circulation.

d. The practice of wearing workout clothing specifically designed to restrict sweat evaporation (portable saunas) is not authorized in a hot field environment. The practice is extremely dangerous and has no place in a physical conditioning program.

5. Work Schedules. Work schedules must be tailored to the situation. When temperatures are high, work must be curtailed or even suspended under severe conditions. The temperature at which work schedule modification will take place depends on humidity, radiant heat, wind velocity, character of the work, degree of acclimatization, and other factors. Work can be scheduled during the cooler hours of the day, such as morning and evening, and still meet the workload requirement.

6. In Garrison Area Prevention. The effects of thermal stress can be lessened within an area while in garrison by employing a few shading techniques to provide protection from the radiant sun rays. Camouflaged netting can reduce temperatures inside tents and other facilities exposed to the direct rays of the sun. This is especially important in common use areas such as dining tents, recreation areas, and berthing. Hydration of troops should be promoted by providing protected sources of cool drinking water in numerous locations throughout the camp.

7. Careful monitoring of the WBGT index is essential to the prevention of heat injury (see article 9-36).

9-36. Wet Bulb, Globe Temperature (WBGT) Index.

1. The WBGT Index is the most effective means of assessing the effect of heat stress on the human body. Heat casualties can be expected at WBGT readings of 75 degrees F. and above unless preventive measures are instituted. Heavy work can cause heat injury at lower temperatures especially if body armor or protective clothing is worn.

2. While in garrison, area commanders and commanding officers are responsible for procuring and maintaining WBGT equipment and conducting readings for their area. While deployed to AOs in the field, medical personnel are relied upon to have, operate, and maintain WBGT equipment and post flag conditions. The WBGT kits are found in Appendix C. Procedures, recording, and posting requirements are listed in Appendix C. Careful monitoring and adherence of procedures and equipment maintenance is necessary to ensure valid assessment of WBGT conditions. Ensure readings are:

a. Taken in an unshaded area most likely to reflect conditions experienced by troops.

b. Taken with clean equipment, clean water etc.

c. Taken with appropriate materials, i.e. a clean 100% cotton wick which extends into the water and above the thermometer reservoir.

d. Recorded consistently in a heat stress log.

3. The WBGT Index is a single number derived mathematically from three distinct temperature measurements: wet bulb temperatures, dry bulb temperatures, and globe temperatures. Color coded flags are flown in strategic locations so that all personnel will be aware of the current heat stress index and make appropriate work

schedule adjustments.

a. When the WBGT Index is <80, extremely intense physical exertion may precipitate heat exhaustion or heat stroke, therefore, caution must be taken. A white flag is flown at this condition level.

b. When the WBGT index is between 80 and 84.9, discretion is required in planning heavy exercise for unacclimatized personnel. This is a marginal heat stress limit for all personnel. A green flag is flown at this condition level.

c. When the WBGT index is between 85 and 87.9, strenuous exercise and activity must be curtailed for new and unacclimatized personnel during the first 3 weeks of heat exposure. Outdoor classes in the sun must be avoided when the WBGT Index exceeds 85. A yellow (amber) flag is flown at this condition level.

d. When the WBGT index is between 88 and 89.9, strenuous exercise must be curtailed for all personnel with less than 12 weeks training in hot weather. A red flag is flown at this condition level.

e. When the WBGT index is 90 or above, physical training and strenuous exercise must be suspended for all personnel. (excludes operational commitment not for training purposes). A black flag is flown at this level.

f. Wearing body armor or NBC protective uniforms adds approximately 10 points to the measured WBGT. Limits of exposure should be adjusted accordingly.

schedule adjustments.

a. When the WBGT Index is <80, extremely intense physical exertion may precipitate heat exhaustion or heat stroke, therefore, caution must be taken. A white flag is flown at this condition level.

b. When the WBGT index is between 80 and 84.9, discretion is required in planning heavy exercise for unacclimatized personnel. This is a marginal heat stress limit for all personnel. A green flag is flown at this condition level.

c. When the WBGT index is between 85 and 87.9, strenuous exercise and activity must be curtailed for new and unacclimatized personnel during the first 3 weeks of heat exposure. Outdoor classes in the sun must be avoided when the WBGT Index exceeds 85. A yellow (amber) flag is flown at this condition level.

d. When the WBGT index is between 88 and 89.9, strenuous exercise must be curtailed for all personnel with less than 12 weeks training in hot weather. A red flag is flown at this condition level.

e. When the WBGT index is 90 or above, physical training and strenuous exercise must be suspended for all personnel. (excludes operational commitment not for training purposes). A black flag is flown at this level.

f. Wearing body armor or NBC protective uniforms adds approximately 10 points to the measured WBGT. Limits of exposure should be adjusted accordingly.

Section VI. PREVENTION OF COLD INJURIES

Article

9-37. General.

1. Cold injury is defined as tissue damage produced by exposure to cold. The type of injury depends on the degree of cold, the duration of exposure, and environmental and physiological factors.

2. Cold injury can occur at nonfreezing and freezing temperatures although their pathology will be very similar.

a. Non-freezing, wet cold injuries are associated with prolonged exposure to cold water, dampness or high humidity. Keeping clothing and exposed extremities dry is the primary preventive measure against this type of injury.

b. Freezing, dry cold injuries are associated with extended exposure to subfreezing temperatures, usually 14 degrees F. or lower when the humidity is low. Whole body insulation is the primary preventive measure against this type of injury.

9-38. Environmental Factors.

1. Ambient air temperatures. The rate of body heat loss is inversely proportional to the temperature of the surrounding air. As temperatures decrease, heat loss increases. Air temperatures do not have to be below the freezing point of water to cause cold injuries. Prolonged exposure to temperatures as high as the 50 degree F. range can cause injury depending on other environmental factors and the degree of personal protection.

2. Humidity. Cold injury is due, in part, to the effect of low temperatures on moisture in or on the body. The higher the moisture content, especially on the skin surface, the more rapid the heat loss. As humidity rises, the temperature at which cold injury can occur also rises. High humidity can also induce sweating which will further reduce body heat.

3. Wind velocity. Heat loss is further influenced by wind velocity when humidity is high. Consult Table 9–8 for wind chill equivalent temperatures.

4. Field situation. Personnel in the field do not always have control over their situations or circumstances. Combat can induce prolonged periods of immobilization. Reduced blood circulation and the inability to generate internal body heat will result. Forces on the move, rapid marching, running or riding in open vehicles will greatly increase the effects of wind velocity.

9-39. Physiological Factors.

1. Age. Within the usual age range of sailors and Marines, age is not significant as a factor of susceptibility to cold injury.

2. Rank. Cold injuries are more likely to occur in “front line” troops and predominately those below the rank of E4. The decreased incidence of cold injury among higher ranks is a reflection of a combination of factors such as experience, receptivity to training, and significantly less exposure.

3. Previous cold injury. A previous episode of cold injury increases the individual’s risk of subsequent cold injury. However, the individual with a previous cold injury is more sensitive to cold and is more likely to take protective actions.

4. Fatigue. Mental weariness may cause apathy leading to neglect of acts vital to survival.

5. Other injuries. Injuries resulting in significant blood loss, shock, or inactivity reduce effective blood flow to extremities and predispose to cold injuries.

6. Psychological factors. Cold injury is more common in passive individuals who tend to display little muscular activity and are prone to pay less attention to personal protective measures.

Estimated wind speed (in mph)	Actual Thermometer Reading (°F)											
	50	40	30	20	10	0	−10	−20	−30	−40	−50	−60
	EQUIVALENT TEMPERATURE (°F)											
Calm	50	40	30	20	10	0	−10	−20	−30	−40	−50	−60
5	48	37	27	16	6	−5	−15	−26	−36	−47	−57	−68
10	40	28	16	4	−9	−24	−33	−46	−58	−70	−83	−95
15	36	22	9	−5	−18	−32	−45	−58	−72	−85	−99	−112
20	32	18	4	−10	−25	−39	−53	−67	−82	−96	−110	−124
25	30	16	0	−15	−29	−44	−59	−74	−88	−104	−118	−133
30	28	13	−2	−18	−33	−48	−63	−79	−94	−109	−125	−140
35	27	11	−4	−21	−35	−51	−67	−82	−98	−113	−129	−145
40	26	10	−6	−21	−37	−53	−69	−85	−100	−116	−132	−148
(wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER (for properly clothed person) Maximum danger of false sense of security.				INCREASING DANGER Danger from freezing of exposed flesh.			GREAT DANGER				
	Trenchfoot and immersion foot may occur at any point on this chart.											

Cooling Power of Wind on Exposed Flesh Expressed as an Equivalent Temperature

Table 9-8. Wind Chill Chart

7. Geographic Origins. Personnel from warmer climates appear to be predisposed to cold injury. However, proper acclimatization will help compensate for this predisposition.

8. Nutrition. Poor nutrition predisposes a person to cold injury. The standard military ration will provide adequate nutrition for appropriately clothed and protected personnel during most cold weather operations.

9. Activity. Too much or too little activity will contribute to cold injury. Over activity, with deep, heavy breathing, generates a large amount of body heat loss. The resulting perspiration,. which becomes trapped in the clothing, markedly reduces the insulating quality of the clothing. Conversely, immobility causes decreased body heat production which results in cooling, especially of the extremities.

10. Drugs and medications. Personnel taking prescription medication must be aware that some drugs have an adverse effect on blood circulation or sweating.

a. Alcohol can impair judgment and will cause dilation of peripheral blood vessels which results in increased heat loss to the environment.

b. The nicotine in tobacco causes the peripheral blood vessels to constrict thereby decreasing blood flow to the extremities.

9-40. Types of Cold Injuries.

1. Immersion syndrome is a serious condition which may occur in as little as 24 hours in environments where the water temperature is below 50 degrees. When water temperatures exceed 50 degrees, injuries occur with exposure from 48 to 72 hours. This syndrome is not limited to the feet. Any skin area, usually an extremity, that is subjected to damp exposure may be affected. Pale, wrinkled skin is a sympton that indicates the need for complete drying out before underlying tissues begin to break down. Once damage to underlying tissues begins, immobilization may occur and recovery is prolonged, with some cases requiring one month or more depending on the extent of damage. Severe cases have required amputation.

2. Frostbite occurs from exposure to ambient or wind-chill temperature below freezing. The time of exposure varies from instantaneous to several hours depending on the temperature, wind velocity, humidity, and protective measures taken. The first symptoms of frostbite are usually a sharp, pricking sensation which reveals a yellow/white, numb area of hardened skin. The most frequently affected parts of the body are the cheeks, nose, ears, chin, forehead, fingers and toes. Permanent tissue damage may result and excision or amputation of the affected area may be required.

3. Hypothermia is the general cooling of the body's core temperature. It usually results when a person, who is not adequately clothed, is exposed to a cold, windy and possibly even wet environment for an extended period of time. Under extreme conditions, hypothermia may result in as little as 5 minutes, particularly if submerged in very cold water.

4. Carbon monoxide poisoning indirectly results from the exposure to cold weather. As fuels are burned to provide warmth, carbon monoxide is given off. The colorless, odorless gas can cause asphyxiation in poorly ventilated spaces. Personnel must be aware of and constantly reminded of the need for adequate ventilation of enclosed spaces where fuel heaters are being used.

5. Snow burn/snow blindness. Normally, much of the

solar radiation which reaches the earth is absorbed into the ground and the surrounding environment. In the snow, however, the majority of the sun's rays are reflected off the facets of ice crystals and are absorbed by the skin or pass into the eye.

9-41. Prevention.

1. Protective clothing. Wear or carry adequate amounts of the proper types of clothing for the weather to be encountered. Clothing must be worn in layers so excess layers can be removed before sweating causes the material to lose its insulating properties. Outer layers should be wind resistant. Loose clothing allows for efficient blood circulation and creates air pockets which provide insulation. The clothing must be clean and dry. The rain suit must be large enough to fit over the cold weather clothing. All exposed skin areas need protection from the cold and wind. The face is especially vulnerable to cold injury and as much as 75% of body heat loss is through the head. Heat injuries may occur in cold weather operations, so wearing the clothing as stated above can prevent such an occurrence.
2. Care of the feet. The feet must be given special attention. Cold weather, insulated, rubber boots (black or white) will be issued to troops during cold weather operations. Frequent changes of socks is important with these boots because of increased sweating, retention of sweat and a lowered resistance to fungal infections. Sweat in these boots can lead to softening of the soles of the feet which can result in skin loss, infection and hospitalization (see immersion syndrome). Cold injuries can still occur in these boots if the feet are not exercised. In any boot, the feet are more prone to sweating than other parts of the body. Moisture in the socks will reduce their insulating quality making frequent sock changes a must. Wet socks can be dried by placing them unfolded inside the shirt. Extra socks must be carried at all times and dirty socks washed whenever possible. Sweating of the feet may be controlled by the use of antiperspirants containing aluminum chlorhydrate. Feet should be massaged daily, toenails trimmed (not too short), and blisters cleaned and protected.
3. Protection of the hands. Mittens are more protective than gloves and individuals should keep a dry pair for use whenever possible. Gloves present more surface area for heat loss and are therefore less efficient than mittens in keeping hands and fingers warm. When wet, leather gloves must be dried slowly to prevent shrinking and hardening of the leather. The wool liners must be dried slowly to prevent shrinking.
4. Personal hygiene. Proper personal hygiene must be maintained in cold weather operations. Personnel involved in field operations may neglect basic hygiene and become susceptible to skin disease because of the lack of hot water and convenient washing facilities.
5. Exercise. Avoid immobilization. Exercise of large muscle groups will generate internal body heat. Wiggling the fingers and toes will increase circulation and keep them warm. Massage the ears and nose periodically for the same reason. When exercise is not possible, frequent changes of position will encourage circulation.
6. Sunglasses/Sunscreen. When working in snow conditions, use of sunscreen and sunglasses is strongly recommended. Sunglasses must be worn during daylight hours regardless of whether the sun is shining brightly or not. A bright, cloudy day is deceptive and can be as dangerous to the eyes and skin as a day of brilliant sunshine. The glasses will also protect against blowing snow. The risk of snow blindness and sunburn is increased at high altitudes because the clear air allows more of the burning rays of sunlight to penetrate the atmosphere.
7. Diet. Increased caloric intake, especially in the form of carbohydrates, is important for the production of internal body heat. Proper diet includes hydration. Adequate water intake is as important in cold environments as in hot. Personnel, bundled up in layers of protective clothing, may not be aware of the amount of sweat they are losing. Water discipline must be enforced in cold environments.
8. The Buddy System. Personnel must be trained to recognize signs of cold injuries on other individuals. When blanching of the skin is noted, immediate action will usually prevent the development of cold injury. Holding (not rubbing) a warm hand on the blanched area until it returns to a normal color is an effective treatment for a cold ear, nose or cheek. Fingers can be warmed against the bare abdomen, chest or armpit. If the casualty complains of an abrupt loss of cold sensation or extreme discomfort in the affected body part, immediate action must be taken as these are classic early warning signs of frostbite.

solar radiation which reaches the earth is absorbed into the ground and the surrounding environment. In the snow, however, the majority of the sun's rays are reflected off the facets of ice crystals and are absorbed by the skin or pass into the eye.

9-41. Prevention.

1. Protective clothing. Wear or carry adequate amounts of the proper types of clothing for the weather to be encountered. Clothing must be worn in layers so excess layers can be removed before sweating causes the material to lose its insulating properties. Outer layers should be wind resistant. Loose clothing allows for efficient blood circulation and creates air pockets which provide insulation. The clothing must be clean and dry. The rain suit must be large enough to fit over the cold weather clothing. All exposed skin areas need protection from the cold and wind. The face is especially vulnerable to cold injury and as much as 75% of body heat loss is through the head. Heat injuries may occur in cold weather operations, so wearing the clothing as stated above can prevent such an occurrence.

2. Care of the feet. The feet must be given special attention. Cold weather, insulated, rubber boots (black or white) will be issued to troops during cold weather operations. Frequent changes of socks is important with these boots because of increased sweating, retention of sweat and a lowered resistance to fungal infections. Sweat in these boots can lead to softening of the soles of the feet which can result in skin loss, infection and hospitalization (see immersion syndrome). Cold injuries can still occur in these boots if the feet are not exercised. In any boot, the feet are more prone to sweating than other parts of the body. Moisture in the socks will reduce their insulating quality making frequent sock changes a must. Wet socks can be dried by placing them unfolded inside the shirt. Extra socks must be carried at all times and dirty socks washed whenever possible. Sweating of the feet may be controlled by the use of antiperspirants containing aluminum chlorhydrate. Feet should be massaged daily, toenails trimmed (not too short), and blisters cleaned and protected.

3. Protection of the hands. Mittens are more protective than gloves and individuals should keep a dry pair for use whenever possible. Gloves present more surface area for heat loss and are therefore less efficient than mittens in keeping hands and fingers warm. When wet, leather gloves must be dried slowly to prevent shrinking and hardening of the leather. The wool liners must be dried slowly to prevent shrinking.

4. Personal hygiene. Proper personal hygiene must be maintained in cold weather operations. Personnel involved in field operations may neglect basic hygiene and become susceptible to skin disease because of the lack of hot water and convenient washing facilities.

5. Exercise. Avoid immobilization. Exercise of large muscle groups will generate internal body heat. Wiggling the fingers and toes will increase circulation and keep them warm. Massage the ears and nose periodically for the same reason. When exercise is not possible, frequent changes of position will encourage circulation.

6. Sunglasses/Sunscreen. When working in snow conditions, use of sunscreen and sunglasses is strongly recommended. Sunglasses must be worn during daylight hours regardless of whether the sun is shining brightly or not. A bright, cloudy day is deceptive and can be as dangerous to the eyes and skin as a day of brilliant sunshine. The glasses will also protect against blowing snow. The risk of snow blindness and sunburn is increased at high altitudes because the clear air allows more of the burning rays of sunlight to penetrate the atmosphere.

7. Diet. Increased caloric intake, especially in the form of carbohydrates, is important for the production of internal body heat. Proper diet includes hydration. Adequate water intake is as important in cold environments as in hot. Personnel, bundled up in layers of protective clothing, may not be aware of the amount of sweat they are losing. Water discipline must be enforced in cold environments.

8. The Buddy System. Personnel must be trained to recognize signs of cold injuries on other individuals. When blanching of the skin is noted, immediate action will usually prevent the development of cold injury. Holding (not rubbing) a warm hand on the blanched area until it returns to a normal color is an effective treatment for a cold ear, nose or cheek. Fingers can be warmed against the bare abdomen, chest or armpit. If the casualty complains of an abrupt loss of cold sensation or extreme discomfort in the affected body part, immediate action must be taken as these are classic early warning signs of frostbite.

Section VII. DISEASE CONTROL

9–42. General.

1. Communicable diseases are those diseases that are transmitted from a carrier to a susceptible host. They may be transmitted directly from an infected person or animal or indirectly through the agency of an intermediate host, vector or inanimate object. The illness produces results from infectious agents invading the host and multiplying or from the release of their toxins.

2. Disease control, as it pertains to the field or combat

situation, cannot be overemphasized. Prevention is the key to a successful disease control program and may mean the difference between success or failure of the mission. Disease occurrence requires a “chain of transmission” consisting of four links: a reservoir, a means of transmission, a portal of entry, and a susceptible host. To prevent or control communicable diseases it is necssary to “break” one or more of the links in the chain.

3. As discussed in Section 1, the medical department must ensure the 100% medical deployability of the unit. This can only be achieved through constant maintenance and updating of medical readiness programs such as immunizations, tuberculosis control, hearing conservation, physical exams, G6PD screening, etc. With all personnel in 100% compliance, these programs will not have to be brought up to date a few days prior to a deployment. The time prior to deployment is needed to obtain and review medical intelligence for the AO and prepare for and initiate any special preventive medicine programs indicated by the medical intelligence.

9-43. Diseases of Military Importance.

1. Intestinal diseases are caused by the ingestion of infectious microorganisms or their waste products. They are often transmitted by food or water which has become contaminated with bacteria, viruses or intestinal parasites. These infectious agents are introduced as a result of a breakdown in personal hygiene, sanitation, food preparation or water treatment. Food or water becomes contaminated by direct contact with the infectious agent or by contact with a mechanical vector such as flies, rodents, etc.

a. Some intestinal diseases of particular importance to the military in field environments are typhoid and paratyphoid fevers, amebic dysentery (amebiasis), bacillary dysentery (Shigellosis), cholera, hepatitis, leptospirosis, food infection and food intoxication. Symptoms typically associated with these diseases include abdominal cramps, diarrhea, fever, nausea, dehydration, jaundice, vomiting and weakness. (Consult Chapter I of this manual for detailed information on the control of food borne illness.)

b. Control is relatively easy in that the infectious agents are ingested. Therefore, proper handling, storage, inspection and preparation of food, (Section III of this chapter and Chapter I of this manual), and adequate treatment of potable water supplies, (Section II of this chapter and Chapters 5 and 6 of this manual), will effectively eliminate intestinal diseases in a field unit. Troop education is strongly emphasized.

2. Diseases of the respiratory tract are caused by direct inhalation of infectious microorganisms which are carried on airborne droplets or dust particles. These bacteria and viruses may also be indirectly transmitted through ingestion by the use of common cups, food utensils, cigarettes, etc.

a. Some diseases which can be spread in this manner are influenza, common colds, diphtheria, rubella, rubeola, pneumonia, scarlet fever, strep throat and tuberculosis. Symptoms range from mild fevers to permanent incapacitation.

b. Control involves:

(1) Isolation of known or suspected cases, where practical. Avoidance of overcrowding and close physical contact is ideal but will be dictated by the tactical situation.

(2) Frequent ventilation of living spaces.

(3) Providing medical surveillance, education and patient/contact interviewing.

(4) Providing prophylactic immunization/treatment of susceptible personnel.

(5) Use of personal protection devices such as dust masks/scarves to reduce exposure to noxious or infectious dusts, spores etc.

3. Vector-borne diseases

a. Arthropods transmit many communicable diseases. Two classes of arthropods involved are insects (fleas, flies, lice, mosquitoes, etc.) and arachnids, (ticks, mites, spiders, etc). Diseases transmitted by these vectors may include malaria, yellow fever, sandfly fever, typhus, plague, spotted fever, dengue and hemorrhagic fevers. Troop morale and major operations will be adversely affected, and relapse and extended recovery time can be anticipated with these diseases.

b. Transmission occurs in two ways. Mechanical transmission is the carrying of disease agents on or in the body of the vector with deposition on food, water, open sores or soil which is inhaled as dust. Biological transmission occurs when a vector ingests the disease agent by feeding on an infected person or animal. At this point, the infectious agent can remain the same, multiply, and transform within the body of the vector. The disease is transmitted to a susceptible host when the vector bites, defecates or regurgitates on the host with subsequent introduction of infectious agents into the blood or other tissues.

c. Control involves:

(1) Surveillance for vector identity, prevalence and breeding sites.

(2) Chemical applications targeted to one of the stages in the life cycle of the infected vector. Consult Chapter 8 of this manual for detailed instructions on chemical control of vectors.

(3) Physically controlling the vector by eliminating breeding sights and harborages; properly using netting, screens, protective clothing, etc.; the liberal use of approved repellents.

(4) Obtaining and using prophylactic medications such as doxycycline or chloroquine and primaquine for malaria prevention, or vaccination for Japanese encephalitis virus.

4. Parasitic Diseases

a. There are a variety of parasitic diseases in which man plays a part in the life cycle, or in which man accidentally becomes infected with a disease agent by unintentionally interrupting the life cycle of a parasite.

b. Some parasitic diseases are the result of poor sanitation, inadequate clothing, or improper cooking methods. All food, particularly food taken from the native countryside, should be thoroughly cooked or disinfected. Fresh fruits and vegetables should be washed carefully and chemically disinfected, as “Night Soil” (human feces) is commonly used as a fertilizer in many underdeveloped nations. All troops should be discouraged from going barefoot and from drinking, bathing and swimming in rivers and streams. It is also commonplace in many areas of the world to defecate or urinate in irrigation ditches which are also used by the local populace as a source of cooking and washing water. Emphasis should be placed on careful disposal of human wastes.

5. Zoonotic Diseases are those transmitted under natural conditions from vertebrate animals (hosts) to man either directly (rabies) or indirectly by vector borne means (plague). The best prevention for this broad group of diseases is avoidance of animals that are acting unnaturally, dead animals and animal nests and burrows. Medical intelligence is essential in identifying enzootic or epizootic diseases in the area of operation (AO).

6. Sexually Transmitted Diseases (STD) are passed from one person to another by intimate sexual contact. The types of STD most frequently encountered in field environments are gonorrhea, non gonococcal urethritis, chancroid, syphilis, lymphogranuloma venereum, herpes and verneral or genital warts (condylomata acuminata). In recent years, gonorrhea has developed a resistance to penicillin therapy (i.e., penicillinase producing *Neisseria gonorrhea*, PPNG). This is particularly true in the Far East and Indian ocean areas. Refer to current instructions and literature for appropriate therapy. Vigorous educational efforts must be made prior to and during a deployment in order to effectively reduce STD morbidity. Lectures/training should emphasize abstinence and the correct use of condoms. In planning for deployments in countries where prostitution is legal or widespread, the local availability of condoms should be considered.

7. *Other Diseases of Military Importance*

a. *Pediculosis* is an infestation of lice on various parts of the body, depending on the species of the louse. The adult lice and eggs (nits) generally stay in the hairy parts of the body or in the clothing worn close to the body, particularly in the seams. Lice are spread from person to person by direct contact or by indirect contact such as sharing of clothing, head gear or sleeping bags.

b. *Scabies* is an infectious disease of the skin caused by a mite. Penetration of the skin is visible as papules, vesicles, or tiny linear burrows containing the mites and their eggs. Mite lesions are prominent in the webbing between the fingers, anterior surfaces of wrists and elbows, anterior axillary folds, belt line, thighs and exterior genitalia in men. Nipples, abdomen and lower portion of the buttocks are frequently affected in women. The transmission of mites is by direct, skin-to-skin contact, frequently during sexual contact and to a limited extent, from undergarments or soiled bed clothes freshly contaminated by an infected person.

8. *Venomous Animals.* There are numerous species of venomous animals throughout the world. Prior to deployment, a thorough review of available medical intelligence is necessary. Once dangerous and venomous species are identified, troop education will help reduce morbidity and mortality from these sources. In some cases, anti-venoms are available, and should be included in medical supplies if practical. If the anti-venoms are too expensive or fragile to take on the deployment, identification of their nearest location must be. made prior to deployment.

9-44. Communicable Disease Reporting.

1. Regulations pertaining to communicable disease reporting are contained in NAVMEDCOMINST 6220.2 series, Disease Alert Reports. These reports are required for specified diseases or increased sick call morbidity that may affect operational readiness, be a hazard to the community, be spread through transfer of personnel, require diagnostic, epidemiologic, or other medical assistance or be of such political or journalistic significance that inquiry may be made to the Bureau of Medicine and Surgery or higher authority.

2. Disease Alert Reports are to be initiated by the medical unit that initially suspects or diagnoses disease occurrence as noted above, usually the Battalion or Regimental Aid Station. Further guidance may be obtained from organic Preventive Medicine Services, the area Naval Hospital Preventive Medicine Department, or the cognizant Navy Environmental and Preventive Medicine Unit.

APPENDIX A

SOURCES OF MEDICAL INTELLIGENCE FOR THE NAVY AND MARINE CORPS

A-1. Officer in Charge
Navy Environmental and Preventive
Medicine Unit No. 2
Naval Station, Norfolk, VA 23511-6288
AV 564-7671
COM (804) 444-7671
FAX (804) 444-1191

A-2. Officer in Charge
Navy Environmental and Preventive
Medicine Unit No. 5
Box 143
Naval Station, San Diego, CA 92136-5143
AV 526-7070
COM (619) 556-7070
FAX (619) 556-7071

A-3. Officer in Charge
Navy Environmental and Preventive
Medicine Unit No. 6
Box 112
Pearl Harbor, HI 96860-5040
AV 471-9505
COM (808) 471-9505
FAX (808) 474-9361

A-4. Officer in Charge
Navy Environmental and Preventive
Medicine Unit No. 7 (Naples, IT)
FPO New York, 09521-4200
AV 18-625-1110 ext. 4468/4469
COM 9-011-39-81-724-4468/4469
FAX 39-81-762-4045

A-5. Officer in Charge
Navy Disease Vector Ecology
and Control Center
Naval Air Station
Jacksonville, FL 32212-0043
AV 942-2424
COM (904) 772-2424
FAX (904) 779-0107

A-6. Officer in Charge
Navy Disease Vector Ecology
and Control Center
Naval Air Station, Bldg. 130
Alameda, CA 94501-5039
AV 993-2806
COM (510) 263-2806
FAX (510) 263-2799

A-7. Commanding Officer
Naval Medical Research Unit No. 2 (Manila, RP)
APO San Francisco, CA 96528-5000
COM 632-732-3778
FAX 632-732-3107

A-8. Commanding Officer
Naval Medical Research Unit No. 3 (Cairo, Egypt)
FPO New York 09527-1600
COM 39-81-202-350-6854
FAX 011-202-282-2039

A-9. Officer in Charge
U.S. Naval Medical Research
Institute Detachment (Lima, Peru)
APO Miami 34031-0008
COM 39-51-14-529-662

A-10. Officer in Charge
U.S. Naval Medical Research
Institute No. 2 Detachment
APO San Francisco 96356-5000
COM 622-141-4507

A-n. Armed Forces Medical Intelligence Center
Fort Detrick
Frederick, MD 21701-5004
AV 343-7511
COM (301) 663-7511
FAX (301) 663-2409

A-12. Local Naval Hospital/Naval Medical Clinic
Preventive Medicine Services. Note: All medical intelligence data, no matter what form, must be shared with the G-2/4, S–2/4 and other cognizant staff offices.

APPENDIX B

REFERENCE

B-1. Navy Instructions

1. OPNAVINST 5090.1 Series, Environmental and Natural Resources Protection
2. NAVSUPINST 5100.24 Series, Calcium Hypochlorite
3. NAVMEDCOM 6240.1 Series, Standards for Potable Water
4. NAVMEDCOMINST 6220.2 Series, Disease Alert Report
5. BUMEDINST 6222.10 Series, Sexually Transmitted Disease (STD) Clinical Management Guidelines
6. SECNAVINST 6222.1 Series, Policy on Veneral Disease Control
7. NAVMEDCOMINST 6230.1 Series, Viral Hepatitis Prevention
8. NAVMEDCOMINST 6230.2 Series, Malaria Prevention and Control
9. NAVMEDCOMINST 6230.3 Series, Medical Services Immunizations and Chemoprophylaxis

B-2. Marine Corps Orders

1. Marine Corps Order 6200.1 Series, Heat Casualties
2. Marine Corps Order P-10110.14 Series, Food Service and Subsistence Management Manual
3. FMFM 4-5, Medical and Dental Support

B-3. Navy Publications

1. NAVMED P–5038, Control of Communicable Diseases in Man
2. NAVMED P-5010, Chapters 1–8
3. NAVMED P-5052–5, Technical Information Manual for Medical Corps 0fficers, Chapter 5, Prevention and Control of Heat Injury
4. NAVMED P-5041, Treatment of Chemical Agents Casualties and Conventional Military Chemical Injuries

B-4. Army Publications

1. TB MED 576, Sanitary Control and Surveillance of Water Supplies at Fixed Installations
2. TB MED 577, Sanitary Control and Surveillance of Field Water Supplies
3. FM 21-10, Field Hygiene and Sanitation
4. FM 10-23, Basic Doctrine for Army Field Feeding
5. FM 90-3, Desert Operations
6. FM 8–250, Preventive Medicine Specialist

APPENDIX C

WET-BULB GLOBE TEMPERATURE INDEX (WBGTI) SYSTEMS

C–1. *Installation.* This appendix describes the materials required to assemble a WBGT station. Certain items, such as clamps, stoppers, and flasks, have not been addressed but are required to assemble this station. Refer to Marine Corps Order 6200.1 series, Subj: Heat Casualties, Appendix A. Included in this appendix also are two heat stress instruments that *are* currently available in the stock system.

C–2. *Use.* A copy of instructions for the appropriate instrument must be prominently displayed at each WBGT station.

C-3. *Instrument Procurement.* Most instruments have been provided on a one-time basis. Additional instruments may be obtained locally so long as specifications are the same. Sources of the three sets are provided as follows:

a. *Shelter Instrument Thermoscreen.* This item is listed in section L of the Naval Aviation Supply table 00–34–QL–22 under Meteorological Equipment for Aerological Units. The stock number is 5410-00-267-8898, ML-41 (medium standard cotton region-type).

b. *Globes.* These are copper hemispheres, 6 inches in diameter and obtained in pairs. The manufacturer is Arthur Harris and Company, 210-218 North Aberdeen Street, Chicago, Illinois 60607.

c. *Mercury Thermometers.* These instruments are ordinary thermometers of about 30 cm overall length. The range of thermometer is from 30° to 150° F in one increment. The manufacturer is Nurnberg Thermometer Company, Inc. 127 Merrick Road, Rockville Center, New York 11570.

C-4. *Distribution* Those commands in receipt of instruments will install and maintain instrument sites, as required, and provide the readings to subordinate commands for use in the regulation of training when temperatures exceed 80° F.

C-5. *The WBGTI.* This index is a single number derived mathematically from three distinct temperature measurements: wet bulb temperatures, dry bulb temperatures, and globe temperatures. Training programs in warm weather should be planned provisionally on the basis of the WBGTI. Readings are to be taken every hour on the hour from 0800-1700 (local time) or until training is completed. Readings of all thermometers must be taken and recorded at the same time.

a. *INSTRUMENTS*

(1) *The Wet Bulb Thermometer*

(a) The natural Wet-bulb thermometer is an ordinary mercury thermometer, 30° to 150° F, with a wet wick around the bulb and exposed in an unshaded position to natural air movement and to solar radiation. The natural wet-bulb is cooled by natural convection but at the same time is warmed by solar radiation; and therefore, for the same air movement, its reading will be higher than a shaded wet-bulb.

(b) The natural wet-bulb thermometer is suspended from a horizontal arm support by the same upright used to mount the globe thermometer.

(2) *The Dry Bulb Thermometer* This is an ordinary thermometer which measures air temperature and is the only instrument kept inside the thermoscreen shelter.

(3) *The Globe Thermometer*

(a) The Globe thermometer consists of a 6-inch sphere of copper painted matte black on the outside. In to the neck of the globe is inserted an ordinary *mercury* thermometer, 12 inches long and graduated from 30° to 150° F. The thermometer is held in place with a tight-fitting, one-hole rubber stopper; the bulb of the thermometer being centered at the midpoint of the globe.

(b) The Globe thermometer should be mounted from a 6-foot vertical support with a horizontal arm about 36 inches long. The globe is suspended by a sturdy braided flexible wire from the outboard end of the horizontal arm. The center of the globe should be 48 inches from the ground. The arm must point *south* to avoid a shadow of the upright from falling on the globe.

(c) The purpose of the globe thermometer is to combine the thermal effects of the radiation from the sun and hot surfaces in the environment into a single reading. This reading, when related to humidity, will provide a means of estimating total heat stress in the environment.

(d) To perform reliably, the globe must be situated in a widely open area where it will not be shielded in any way from the sun and wind. The ground below should be either grass or gravel. Asphalt surfaces are not desirable.

(e) The globe requires no attention except that the surface should be kept free of dust and streaks and must be repainted each year. After rain, the thermometer should be removed and the globe turned upside down to empty any water that may have leaked in.

(4) *Results.* It can readily be seen that the three instruments described above take into account all four variables of the normal environment; temperature, humidity, radiation, and air circulation.

b. *Formula* The WBGTI is calculated as follows:

Dry-Bulb Temperature	x 0.1
Wet-Bulb Temperature	x 0.7
Globe Temperature	x 0.2
Total	WBGTI

C-6. *Wet Bulb Globe Temperature Kit–NSN 6665-00-159–2218.* The WBGT Kit is enclosed in an aluminum case that contains three different thermometers. The threaded hole in the bottom of the case is used to attach the case to a standard lightweight photographers tripod that is not supplied with this kit. Place the kit with the thermometers toward the sun, with the "black globe" thermometer closest to the sun.

a. A stationary wet bulb thermometer exposed to the sun and prevailing wind.

b. A similarly exposed "black globe" thermometer with a black sheath over the bulb. The sheath and bulb are inside a transparent perforated plastic shield.

c. A dry bulb thermometer with its bulb shielded from the direct rays of the sun by a shield painted white.

d. The WBGTI is determined by utilizing the attached slide rule and readings from the three different thermometers.

C-7. *Wet-Bulb Globe Temperature (WBGT)Meter, NSN 7G 6685-01-055-5298*

a. This instrument is also known as the Heat Stress Meter. It is a compact electronic instrument that independently measures the dry-bulb, wet-bulb, and globe temperatures. The instrument displays each of these values as well as computes and displays the WBGTI.

b. It is lightweight, self-contained, and equipped with a rechargeable power supply.

c. A ventilating fan is included in the shielded dry and wet-bulb sensor assembly to obtain aspirated wet-bulb temperatures.

d. The entire unit can be adapted for remote monitoring and reading.

C-8. *WBGTI Log Sheet.* The provided WBGTI Log Sheet may be locally reproduced, and maintained at each instrument site or a log book may be utilized with the same information. All the readings from each instrument site must be maintained for 1 year.

WBGTI LOG SHEET

Date

Time (Local)	Instrument Inside Shelter	A Enter Dry-Bulb Reading x 0.1 =	Instrument Outside Shelter Globe Thermometer Reading	B Enter Globe Thermometer Reading x 0.2 =	Instrument Outside Shelter Natural Wet-Bulb Thermometer Reading	C Enter Natural Wet-Bulb Thermometer Reading x 0.7 =	Columns A + B + C = WBGTI	Enter Flag Color
0800								
0900								
1000								
1100								
1200								
1300								
1400								
1500								
1600								
1700								

Note: This log sheet may be locally reproduced, maintained at the instrument site, and disposed of after 1 year.

FLAG COLORS AND CORRESPONDING TEMPERATURES

White Flag	Green Flag	Yellow Flag	Red Flag	Black Flag
<80” F	80 to 84.9°F	85 to 87.9° F	88 to 89.9° F	>90° F